ORDNANCE

LAND · SEA · AIR

The Navy's Terrier

MARCH-APRIL 1955

Grinds breech of 4,000 lb. gun barrel

TIMKEN® bearings on work spindle hold runout within .0007"

THIS Bryant Internal Grinder does parallel and tapered grinding jobs —often to a depth of 48″—in the breech end of 4,000 pound gun barrels. To give high accuracy and stability under heavy loads, the huge work spindle is mounted on Timken® tapered roller bearings having a 24″ bore and 32″ O.D.

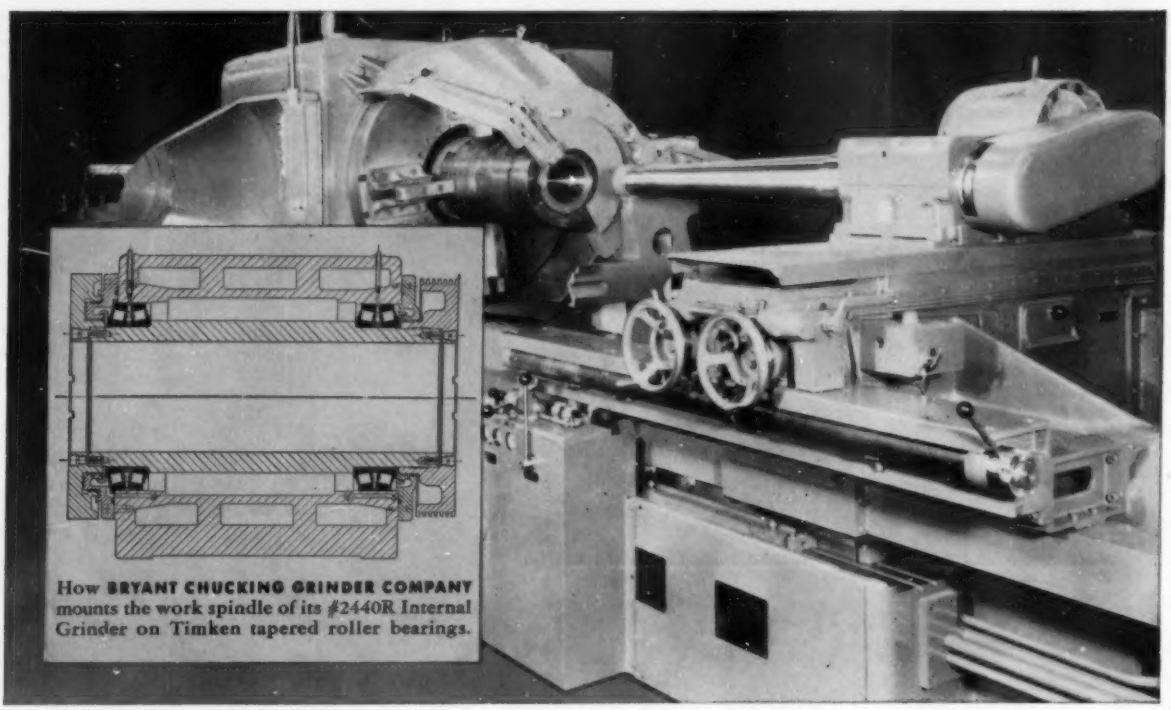
Due to their tapered construction, Timken bearings take radial and thrust loads in any combination. Spindles are held rigid, runout doesn't exceed .0007″. And because of line contact between the rollers and races, Timken bearings have capacity to spare.

Both Timken bearings on the work spindle are mounted with cone spacers so that no manual adjustment is necessary. Spindle maintenance is simplified. And Timken bearings practically eliminate friction because they are geometrically designed to have true rolling motion and precision manufactured to live up to their design.

The end of the work spindle may possibly be bumped by the long, heavy gun tube when chucking a new piece. Timken bearings stand up to these shock loads because the rollers and races are case-hardened. This gives them hard, wear-resistant surfaces over tough, shock-resistant cores. What's more, we make our own steel to check quality every step of the way. No other U. S. bearing maker does.

Specify Timken bearings for the machinery you build or buy. Always look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **BRYANT CHUCKING GRINDER COMPANY** mounts the work spindle of its #2440R Internal Grinder on Timken tapered roller bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

MAGNIFYING GLASS INSPECTION OF EVERY ROLLER!

Every one of the over one billion Timken bearing rollers produced every year is inspected with powerful magnifying glasses to detect surface flaws. It's just one example of how the Timken Company insures uniform high quality.

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◯ AND THRUST →◯← LOADS OR ANY COMBINATION →◯←

ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness

VOL. XXXIX MARCH-APRIL 1955 NO. 209

The Cover.—*The Navy's new antiaircraft guided missile, "Terrier," shown on a launcher aboard the* U.S.S. MISSISSIPPI, *is a supersonic weapon designed to intercept aircraft at much longer ranges and higher altitudes than conventional weapons and under any conditions of visibility.*

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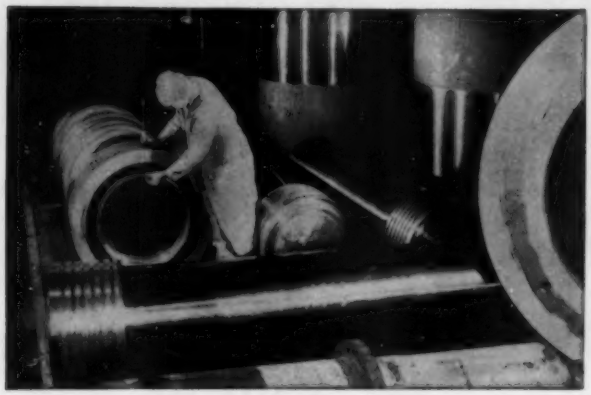
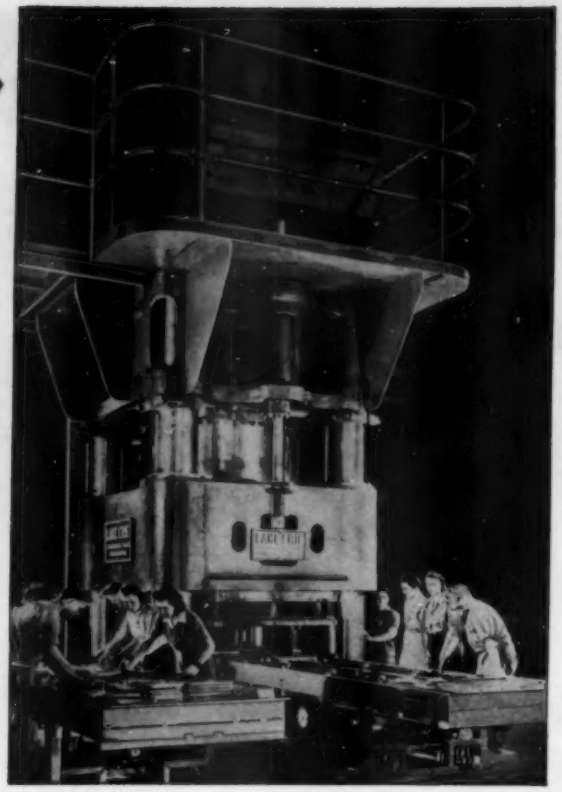
The production capacity of this 5,000 ton forming press, installed in an aircraft plant, is so great it requires 25 persons to load and unload the four tables. To provide dense, sound and uniform structure in hydraulic press rams, Lake Erie specifies the component in nickel cast iron.





Lake Erie's Engineers specify rams of

NICKEL CAST IRON for strength... toughness... tightness

YOU'LL FIND MAXIMUM PRESSURE TIGHTNESS, together with extra toughness and strength, in rams for Lake Erie's powerful hydraulic presses.

Cast iron containing up to 1½ percent nickel provides this combination of properties in all Lake Erie rams.

Suitable additions of nickel to properly adjusted base mixtures provide castings with uniform, fine-grained structures.

In addition, nickel in gray iron minimizes chill and consequently the formation of free iron carbides. This results in strong yet readily machinable castings, without sacrifice of hardness or wear-resistance.

Lake Erie presses also utilize alloys containing nickel for dies as well as many other components.

For instance, on extrusion presses, the containers and container liners are nickel alloy steel forgings. And on many column and side housing types of hydraulic presses you'll find the repeated load of press operation absorbed by platen inserts or wear plates of nickel-chromium steel.

In many applications, alloys containing nickel give optimum performance and prove lowest in ultimate cost. So, whenever you have a metal problem, send us the details. We'll be glad to help you with suggestions based on wide practical experience.

INCO TRADE MARK

The International Nickel Company, Inc.
67 Wall St., New York 5, N. Y.

Please send me booklet entitled, "Guide to the Selection of Engineering Irons."

Name_____ Title_____

Company_____

Address_____

City_____ State_____

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

ALL-PURPOSE TOOL

...what a job it can do for you!

You're looking at a Cat* HT4 Shovel cleaning up around a stockpile in the Kaiser Bauxite Company's Port Kaiser, Jamaica, Plant. This is just one of the many jobs this versatile shovel can do; to mention a few—loading and unloading bulk materials and maintaining roads. What's more, you'll find it can handle these jobs *better, faster* and *cheaper* than any competitive unit!

That's saying a lot, but on-the-job records show the HT4 backs it up with performance. For one thing, it's a *fast* worker. The Caterpillar-built hydraulic system lets the operator raise and dump at the same time, and features an automatic kick-out. Notice how high he sits, with a clear view of the bucket and job. A compact machine, the HT4 can produce in tight spots where bigger equipment can't. Weight, power and bucket capacity are *balanced* for maximum work capacity.

Another factor in the HT4's big production: *stamina.* This rugged rig can really take a beating. Here are a few examples of its extra-strong construction. Frame and mounting and lift arms are all welded and cross-braced to prevent weaving or sidesway. The bucket has a heat-treated, high-carbon steel cutting edge for longer wear. The hydraulic system is enclosed, safe from dirt and grit. All these and other important details add up to a long, useful working life with a minimum of down time.

Have you work in mind for the HT4? Your Caterpillar Dealer will be glad to show you what it can do on your job. Name the place and date—he'll demonstrate!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

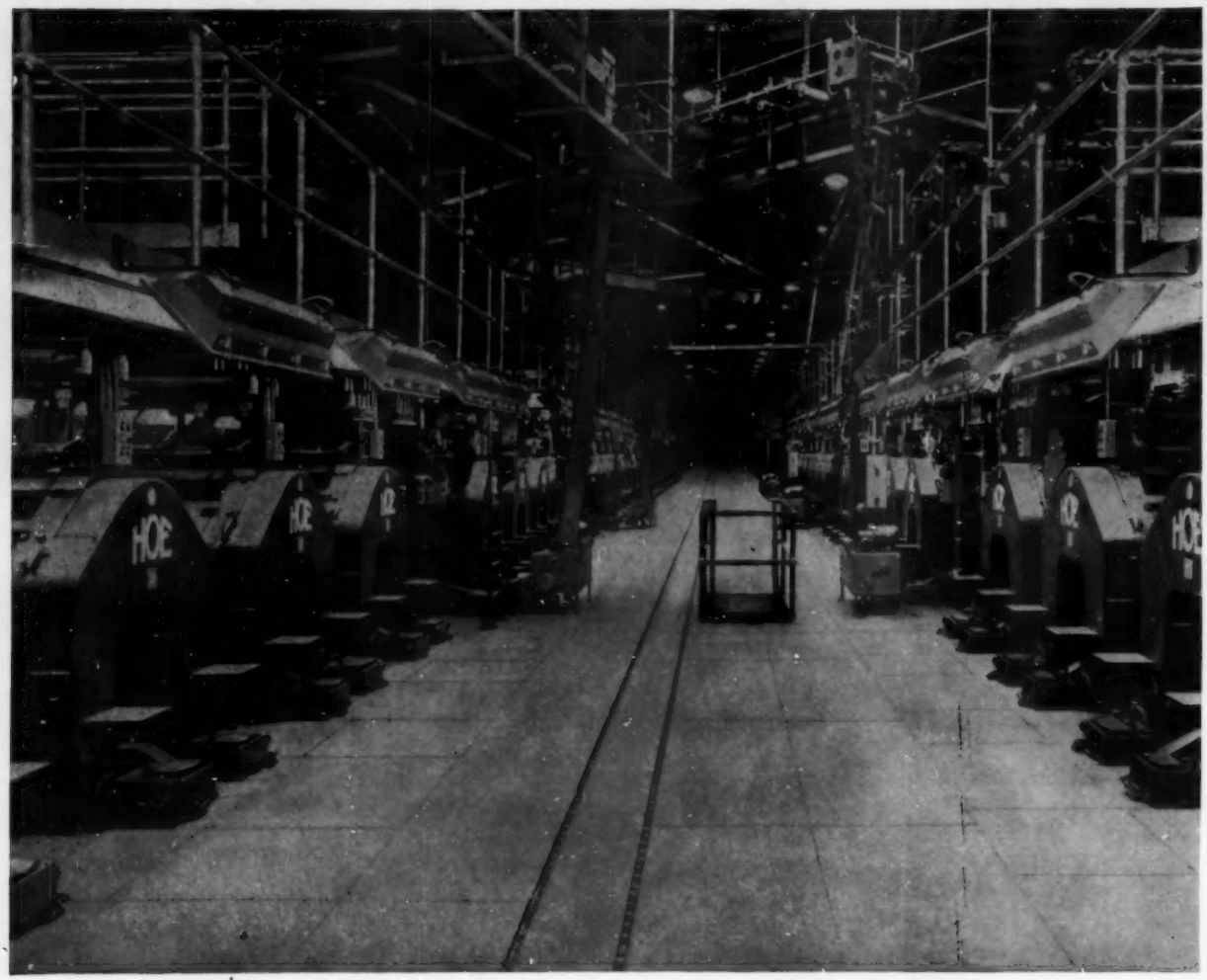
CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

HOE

manufacturer of ordnance for over 100 years



View of pressroom in new home of Philadelphia *Bulletin*. These HOE presses form the longest continuous lines of newspaper press equipment in the world, extending over 319 feet. HOE engineers and machinists are accustomed to maintaining tolerances of ±.0005" on heavy machine construction.

—— *offers complete facilities and skilled personnel for the production of precision machinery and ordnance*

Beginning with the construction of a 3-inch cannon in 1847—over a century ago—HOE has built ordnance equipment for every major war in which the United States has been involved. From World War II HOE has built periscope mounts for tanks, recoil mechanisms for 3-inch and 90 mm antiaircraft guns, recoil mechanisms for 105 mm and 155 mm howitzers, the recoil mechanism for the 280 mm atomic cannon, and various other types of ordnance.

As the leading American manufacturer of newspaper and magazine presses for 150 years, HOE maintains a large foundry, machine shops and ample assembly floor capacity. These facilities, with the most modern machine tool equipment, enable HOE to construct many other types of heavy precision machinery.

Besides making recoil mechanisms, gun turrets, gun mounts and other military equipment, for many years HOE has been building such a wide diversity of products as deep hole drillers, lathes, profiler machines and jet aircraft parts.

Here's what HOE offers:

- 60-ton-a-day foundry can furnish any desired grade of gray iron, semisteel and alloyed castings, in sizes from a few pounds to 10,000 pounds.
- Skilled foundry staff including metallurgists and process engineers.
- Completely equipped machine shops, with all tools and facilities required by modern shop practice.
- Ample floor space for the erection of the largest machines.
- Over 1,800 skilled employees, accustomed to working to extremely fine tolerances.

To furnish more detailed information on HOE's facilities and how HOE can assist you in manufacturing heavy precision products—either parts or complete machines—a HOE representative will be glad to call if you will write or telephone...

Industrial Division

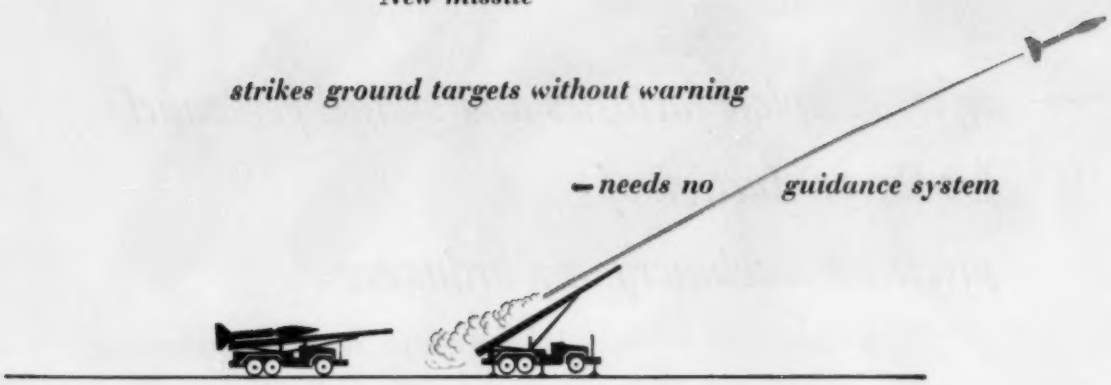
R. HOE & CO., INC.

910 East 138th Street
New York 54, N. Y.
CYpress 2-2400

New missile

strikes ground targets without warning

—needs no guidance system



—the U. S. Army's

Douglas-designed HONEST JOHN

Add to the U. S. Army's ever-growing arsenal of rocket weapons a new ground-to-ground missile . . . the Douglas-designed Honest John.

Developed in co-operation with Army Ordnance—and already being delivered to troop units—Honest John is a free flight rocket without complicated guidance system, and designed to supplement artillery in the medium to heavy range. Honest John is extremely mobile, moves quickly into position on a special truck which also serves as transport *and* launcher. Highly accurate, this rocket can handle either an atomic warhead, or a single high explosive round equalling the explosive force of hundreds of rounds of artillery shells.

Design of Honest John and other missiles is further evidence of Douglas leadership in its field. Now that the time to produce missiles in quantity is come, Douglas manufacturing skill is ready and able for the job.

Depend on *DOUGLAS* **First in Aviation**

90mm shells, fully loaded, are final-checked on this world's largest jumbo automatic gage.

Gages weighing tons check four, six or eight cylinder block bores simultaneously and classify them in selections of .0002.

Principal auto makers use huge multi-column Precisionaires for the simultaneous checking of as many as 34 dimensions of a crankshaft.

JUMBO GAGES for JUMBO JOBS

Automation in mass production calls for conveyors, machine tools and gaging machines of jumbo size to perform jumbo-size jobs.

Cylinder blocks, crankshafts, camshafts, pistons, rings and pins; push rods, king pins, valve lifters; refrigerator pistons, valve plates and thrust rings; small arms ammunition and artillery shells; roller, pin and ball bearings; jet turbine shafts—these are a few typical jumbo jobs gaged by Sheffield jumbo gages. They indicate how Sheffield helps industry produce greater volume at lower cost—for a more profitable operation.

"The world's foremost authority on production gaging" is a distinction often conferred upon Sheffield by reason of the tremendous volume of such equipment, including jumbo gages, which Sheffield produces.

Sheffield engineers would like to discuss your requirements in every field of gaging. *Gage Division, The Sheffield Corporation, Dayton 1, Ohio, U.S.A.*

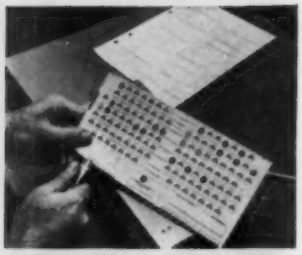
6297

SHEFFIELD MASTER CRAFTSMAN HEADQUARTERS

SHEFFIELD

How your telephone call asks directions... and gets quick answers

1



2

Perforated steel cards, which give directions to the Long Distance dial telephone system, are easy to keep up to date. New information is clipped (1) and punched (2) by hand on a cardboard template. This guides the punch-press that perforates a steel card (3), and the two are checked (4). The new card is put into service in the card translator (5).

↓3

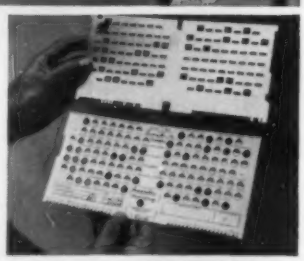
When the Bell System's latest dial equipment receives orders to connect your telephone with another in a distant city, it must find—quickly and automatically—the best route.

Route information is supplied in code—as holes punched on steel cards. When a call comes in, the dial system selects the appropriate card, then reads it by means of light beams and phototransistors. Should the preferred route be in use the system looks up an alternate route.

It is a simple matter to keep thousands of cards up to date when new switching points are added or routing patterns are changed to improve service. New cards are quickly and easily punched with the latest information to replace out-of-date cards.

This efficient, flexible way of keeping your dial system up to the minute was devised by switching engineers of Bell Telephone Laboratories, who are continually searching for ways to improve service and to lower costs. Right now most of the Long Distance dialing is done by operators, but research is hastening the day when you will be able to dial directly to other telephones all over the nation.

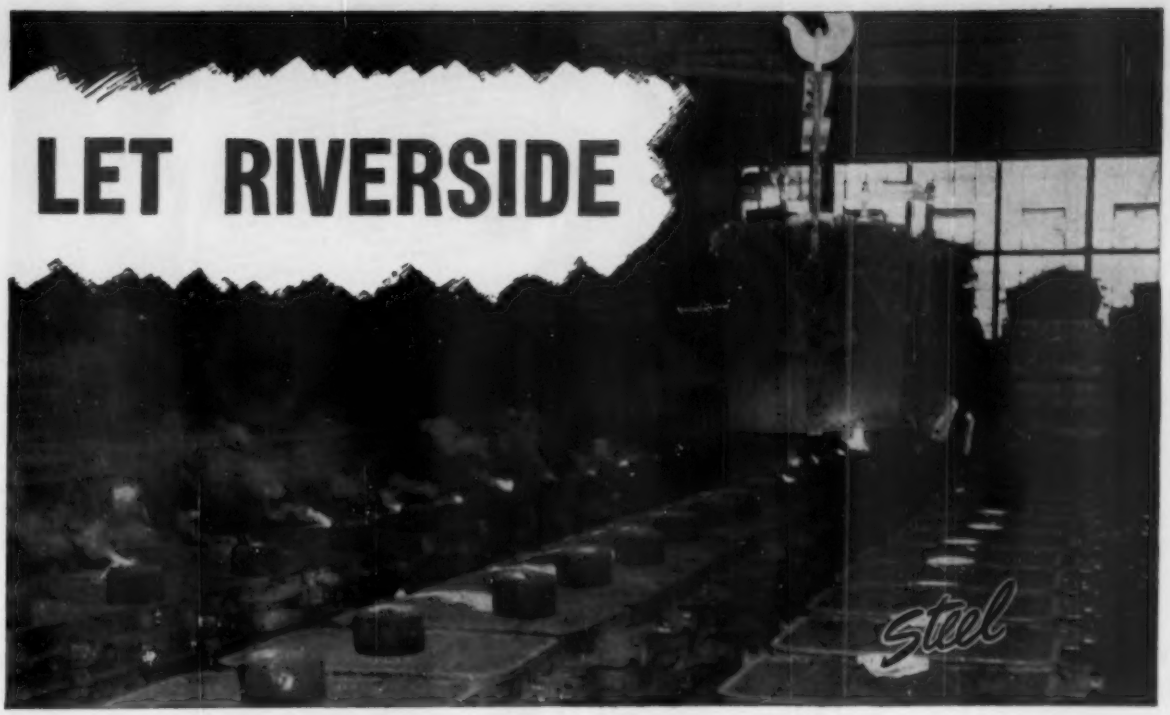
4



5

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.



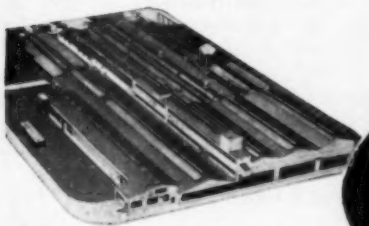
help you solve your Steel Casting Problems

CLEANING CASTINGS FOR EYE-APPEAL
At Riverside the largest batch-type airless blast mill ever built removes scale and sand to assure a product competitive in eye-appeal.

Riverside Foundry is ready to give you excellent service on all ordnance castings. **In fact, any steel casting specifications for which your contract might call.** We have a full staff of men who have spent years producing ordnance material. Our customers include many great names of American Industry: Chrysler, American Locomotive, International Harvester, Fisher Body, Massey-Harris Co., Bowen-McLaughlin-York, Inc. and Ford Motor Company **Ask them about Riverside.**

Call or write us at Riverside today

For a dependable qualified source of steel casting requirements, see Riverside. You give us your drawings. The rest of the job is ours. Save yourself time, worry and loss of production. We are ready to do a complete job for you on any casting requirement.



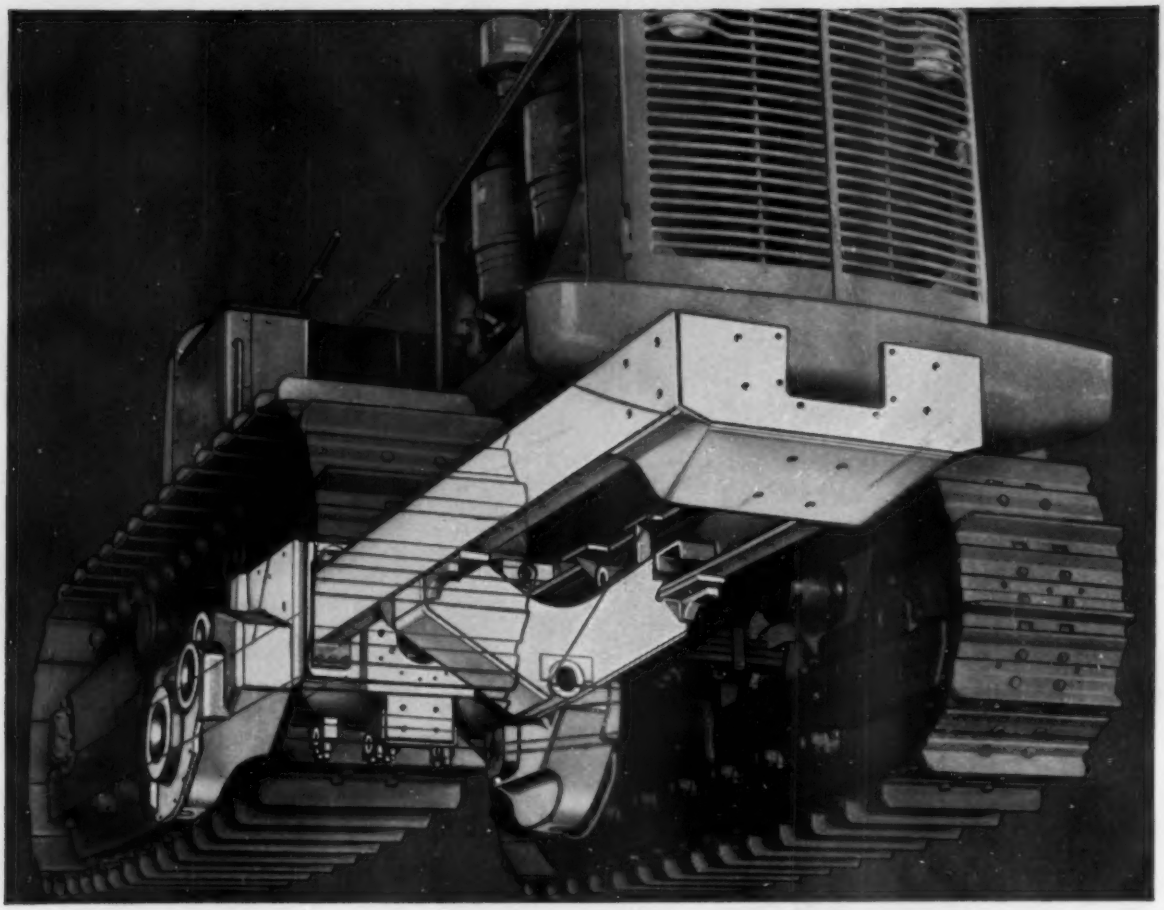
The big modern Riverside Foundry at Bettendorf, Iowa has the best equipment to do the best job.

BETTENDORF, IOWA

RIVERSIDE FOUNDRY

Bettendorf, Iowa Davenport Exchange 5-1811

STEEL and GRAY IRON CASTINGS



Allis-Chalmers Advanced Engineering
THE FOUNDATION OF BETTER PERFORMANCE

Today's earth-moving and construction techniques, plus greater use of mounted equipment, have placed constantly increasing demands on crawler tractor performance. To meet these demands, Allis-Chalmers engineers have completely redesigned their tractors since the war.

Working right from the ground up, they have made full use of new metals and the latest manufacturing processes. Each part is designed and built to meet the requirements of modern job practices, with Allis-Chalmers tractors setting completely new standards of performance. One example of this advanced engineering is the exclusive box A main frame design.

This is typical of the long-range planning and research by which Allis-Chalmers engineering assures longer, more satisfactory performance in both civilian and military machines.

"ROLLS WITH THE PUNCH" — All-steel main frame flexes slightly under extreme shock loads . . . without transmitting strain to engine, clutch or transmission.

BETTER EQUIPMENT MOUNTING — This frame's compactness provides ample clearance for equipment like front-end shovels . . . permits wide track shoes . . . improves performance of entire unit.

IMPROVED WEIGHT DISTRIBUTION — Box A-frame allows location of main components for best over-all balance . . . putting more weight lower in tractor where it does the most good.

SERVICE SIMPLICITY — Since main frame carries *structural* load, power drive components can be readily removed, repaired or replaced without disturbing adjacent parts.

ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE 1, U. S. A.

How Many Mouths Do YOU Feed...
How Many Dishes Need Washing?

Tell HOBART...and Get the Right DISHWASHER!

For *effective, economical* dishwashing, you can't beat Hobart equipment.

Effective, because everyone knows that Hobart design means highest sanitation standards—Hobart construction means the utmost in long, trouble-free performance.

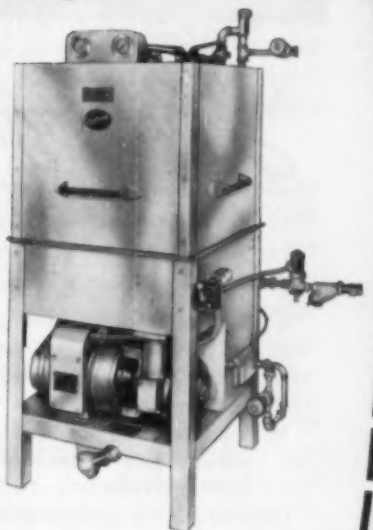
Economical, because Hobart gives you the machine exactly suited to your operation and kitchen layout. With Hobart, you choose from well over 50 machines—from fully or semi-automatic models, with or without Hobart Time Controls—from Hobart Dual-Drive automatics to continuous *Flight-Type* racking machines—from little (2 ft. square), medium or big (26 ft. Flight-Type).

What's more, Hobart offers the same construction and performance advantages all through the entire line—and that includes the greatest line of food, kitchen and dishwashing machines in the industry. Ask locally for the Hobart story—or write... ***The Hobart Manufacturing Company, Troy, Ohio.***

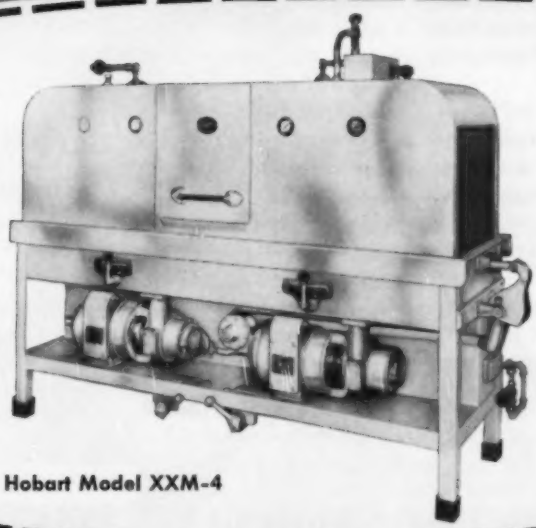
Hobart Model UM-2

HOBART DISHWASHERS proudly bear this SEAL OF APPROVAL

NSF NATIONAL SANITATION FOUNDATION TESTING LABORATORY MEETS STANDARD NO. 3



Hobart Model AM-AC



Hobart Model XXM-4

Trademark of Quality for over 55 years

Hobart Machines

The World's Largest Manufacturer of Food, Kitchen and Dishwashing Machines

For further information on these and other units, write for specification sheets.

Hunting—and the Man Who Was the Wild West

"In a few jumps my horse brought me alongside the rear buffalo. Raising old 'Lucretia Borgia,' I killed the animal with one shot." Chalk up another for William F. Cody, the Old West's own Buffalo Bill.

But Cody, dead-eye plainsman that he was, enjoyed hunting all kinds of game, as his diaries show: "I took the best aim I could get in the dark—the bear rolled over dead," or "The next day was spent in hunting jack-rabbits, coyotes, elk, antelope and wild turkeys." And from a hunt in the Rockies: "We espied a herd of elk, which meant plentiful and excellent meat. We at once started in pursuit." Today, Buffalo Bill is considered the symbol of the American hunter—yet in the field he could get just as tense and excited as a youngster on his first hunt. To Cody, hunting was more than a pastime—it was a challenge, a thrill and a reward rolled into one.

Since pre-Revolutionary days, Americans have looked to hunting for healthy, exciting action. It's a satisfying sport, a sport that challenges wits, reflexes, stamina and skill. Equally important, hunting is known for building self-reliance and endurance . . . in its own way helping to keep our nation strong.

Today, the great American tradition of hunting can be perpetuated only by thoughtful preservation of wildlife. Throughout the country, hunting associations are cooperating with public agencies to promote proper conservation. Do your part in preserving this heritage—join or support one of these groups now. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington 98, Del.

N·R·A RANGER

GET YOUR FREE BOOKLET on how to start a rifle club . . . win Ranger Shooting Emblems. Sportsmen's Service Bureau, Department D-2, Sporting Arms and Ammunition Institute, 250 E. 43rd St., New York 17, N. Y.

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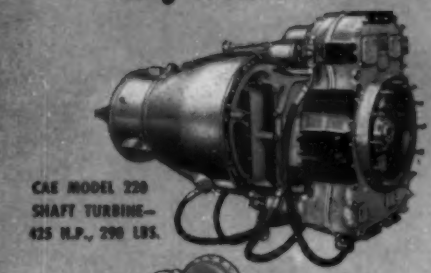
DU PONT SPORTING POWDERS

WORLD-FAMOUS SINCE 1802

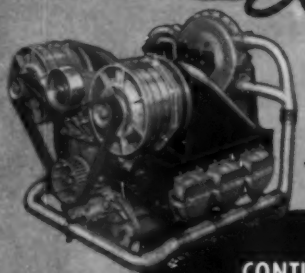
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

CONTINENTAL... Out in Front in Helicopter Power

Outstanding Engines of Both Types... Piston and Turbine... Embody Results of Experience Dating from 1902



CAE MODEL 220 SHAFT TURBINE—425 H.P., 290 LBS.



CMC MODEL FS0470 SUPERCHARGED AND FAN-COOLED HELICOPTER ENGINE—260 H.P.

New, modern helicopters are finding it increasingly beneficial to make use of the latest Continental developments for power production. Two examples of recently tested engines built around Continental power plants are shown. One—the Sikorsky XH-39 at left, above — employs the CAE Model 220 shaft turbine; the other — Cessna's CH-1 at right — uses CMC Model FS0470 piston engine. Both are unique.

The XH-39—first helicopter with completely retractable landing gear — holds the world's record for helicopter altitude (24,500 ft.) and in addition, the world's record for helicopter speed (156.005 m.p.h.). The CH-1 features simplified design, using one-third fewer gears. Location of engine in the nose makes for ease of access, promotes efficient cooling, and frees the center of gravity behind the cockpit for use in disposable load.

Thus Continental supplies each type of power plant to suit the peculiar requirements of two widely different modern helicopter design concepts. Additional power plants engineered for their suitability for helicopters will be forthcoming from the Continental organization within the near future, and great things can be expected.

LOOK AHEAD—JOIN AIR FORCE

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CONTINENTAL MOTORS CORPORATION—Aircraft Engine Division
205 MARKET STREET, MUSKEGON, MICHIGAN

GPE SERVES INDUSTRY THROUGH *coordinated*

The producing companies of General Precision Equipment Corporation are engaged in the development, production and sale of advanced technological products. These products all have a broad common base: 1) they represent precision equipment in some form; 2) they derive from similar fields of technical competence; 3) they save labor, increase productivity, or achieve results which cannot be attained with even limited use of on-the-spot manpower.

A general view of the technical capacities of the GPE Producing Companies is given in the chart. But the chart cannot show the very close interrelation of these capacities nor the highly flexible application of facilities, techniques and capabilities which exists among these companies. This is achieved through GPE's basic operating policy—Coordinated Precision Technology.

GPE Coordinated Precision Technology operates in all areas—in research, development and manufacture. The record of the GPE Producing Companies in solving advanced technological problems and meeting the demand for high speed, precision, reliability, light weight and compactness at competitive prices is the result of this coordination, the constant application of the newest and most highly advanced techniques, and unremitting insistence on highest quality.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment and systems, and of solutions to the underlying technical problems, are not restricted by being confined to the specialized techniques of a particular field. In short, GPE Coordinated Precision Technology permits each company to seek the optimum solution for the customer by the application of all relevant techniques within the total capacities of the entire group. Address inquiries to:

GENERAL PRECISION EQUIPMENT CORPORATION
92 GOLD STREET, NEW YORK 38, NEW YORK

CAPACITIES OF THE GPE PRODUCING COMPANIES

- PRECISION MECHANICS and CERAMICS
- ELECTRICAL EQUIPMENT and COMPONENTS
- ELECTRONICS
- HYDRAULICS and LIQUIDS HANDLING
- PROFESSIONAL and INDUSTRIAL TELEVISION EQUIPMENT
- INSTRUMENTATION
- SERVOS and CONTROLS
- AUTOMATIC COMPUTERS and COMPONENTS
- ULTRASONICS
- RADAR and MICROWAVE
- MOTION PICTURE and SOUND EQUIPMENT
- OPTICAL DEVICES

Over **2200** scientists, engineers, draftsmen, testers and other technical personnel in the GPE Companies work in the fields covered by this chart.

THE GPE PRODUCING COMPANIES

Simplex — INTERNATIONAL PROJECTOR CORPORATION—BLOOMFIELD, N. J.

Peerless — J. E. McAULEY MFG. CO. CHICAGO

GPL — GENERAL PRECISION LABORATORY INCORPORATED—PLEASANTVILLE, N. Y.

Hertner — THE HERTNER ELECTRIC COMPANY—CLEVELAND

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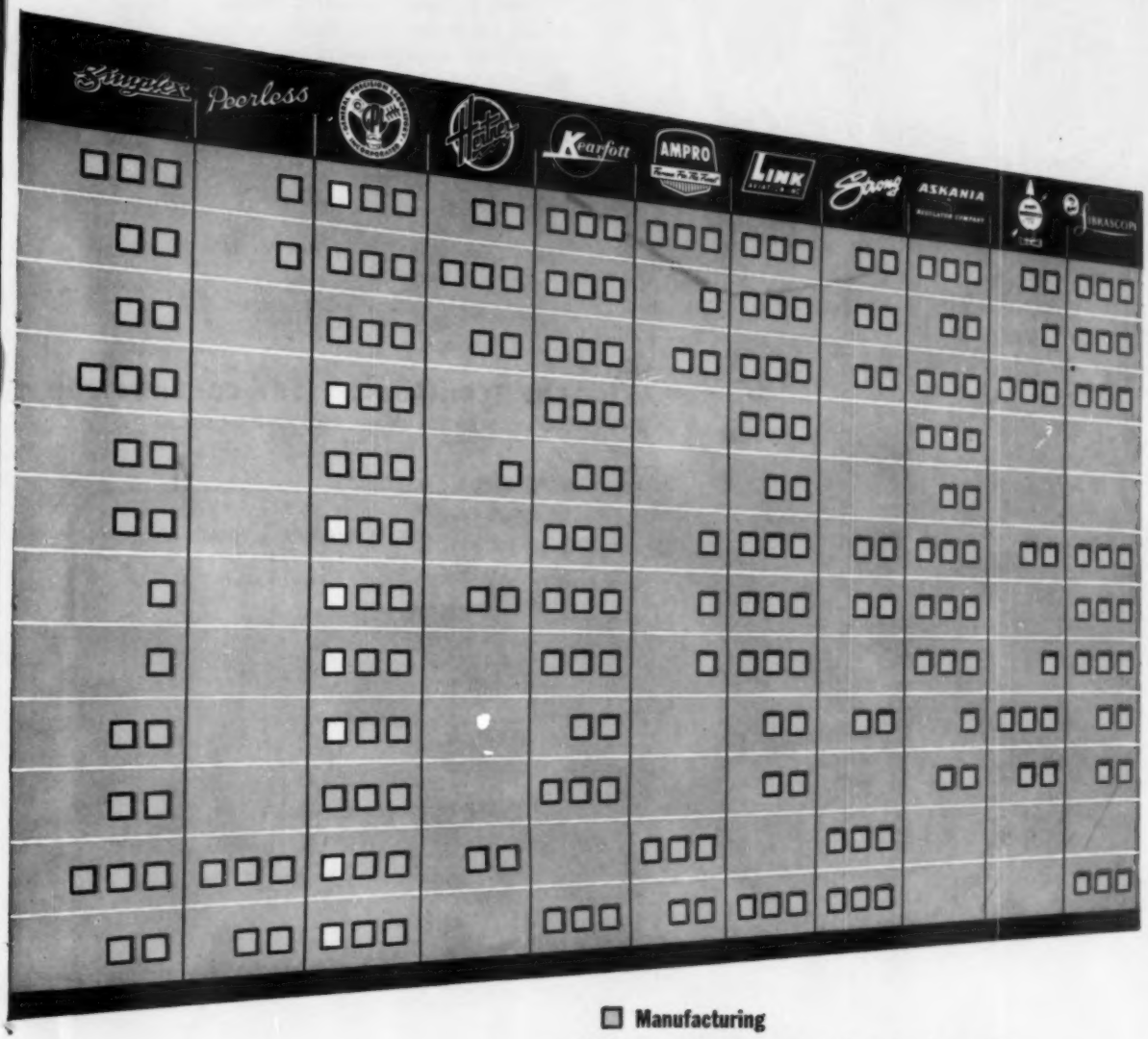
One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

precision technology



□ Manufacturing
□□ Manufacturing and product development
□□□ Manufacturing, product development and research
□□□ Pilot manufacturing, product development and research

AMPRO CORPORATION
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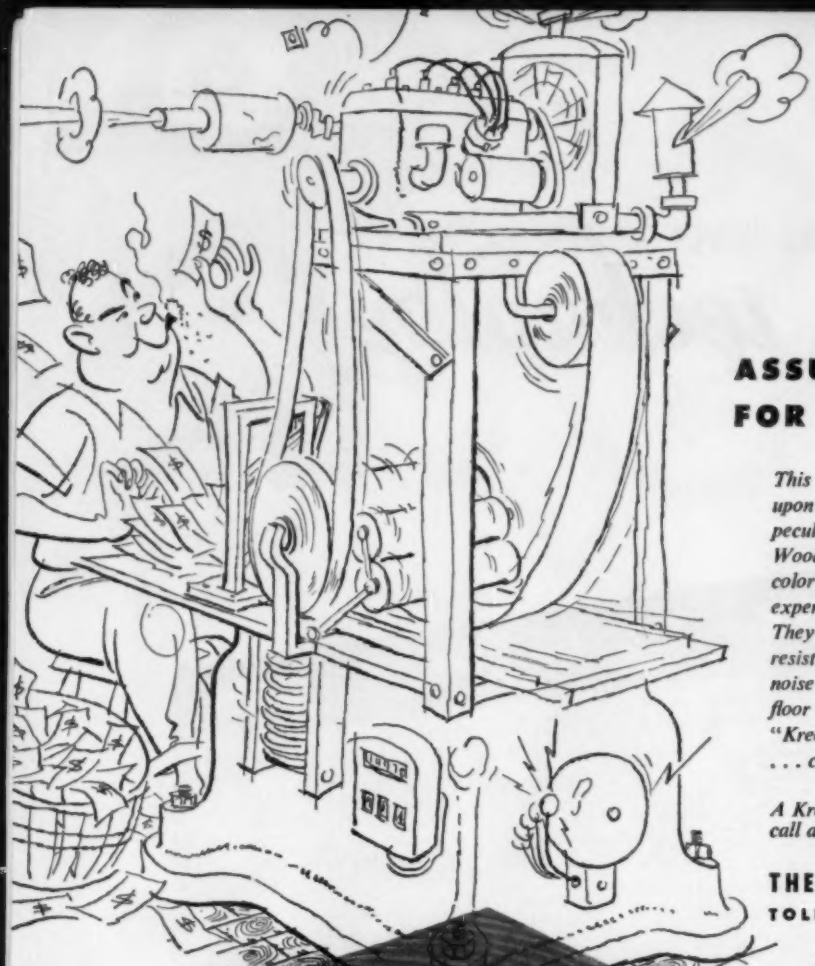
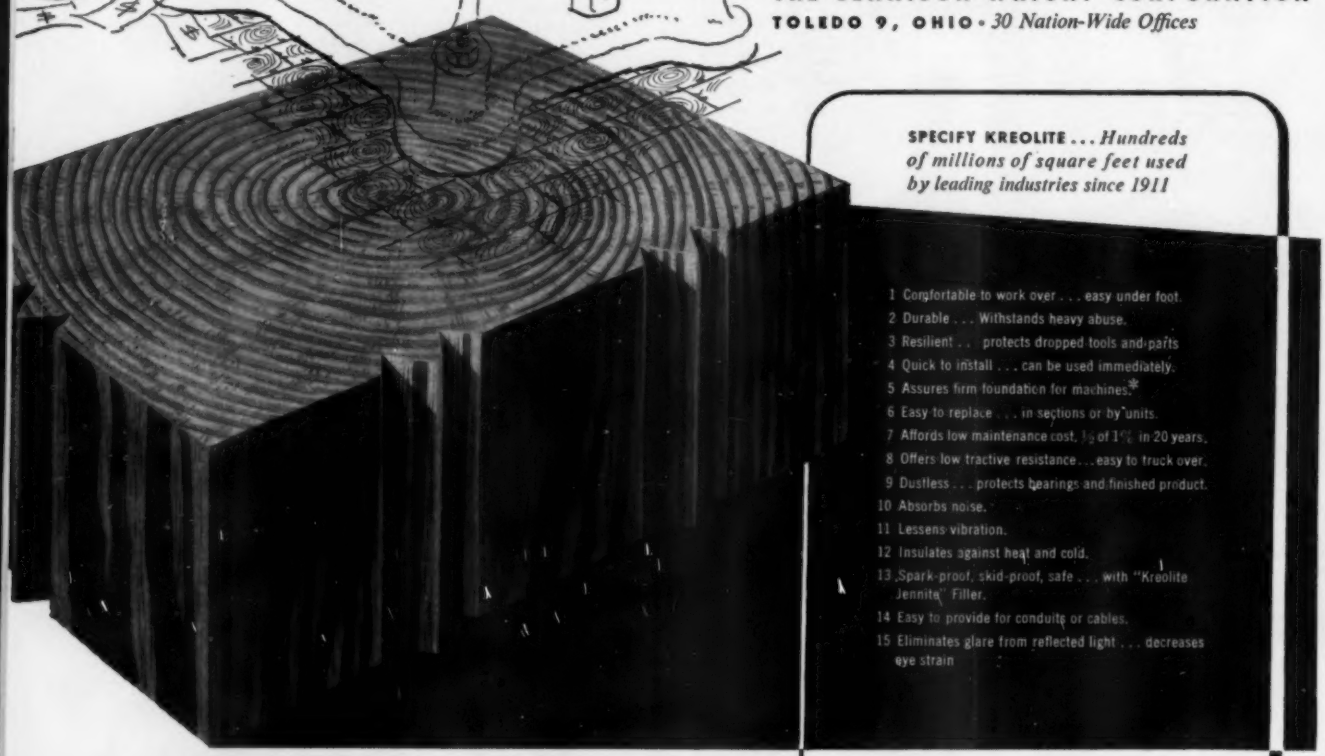


ASSURES FIRM FOUNDATION FOR MACHINES*

This type of a "money-maker" is frowned upon by our government (it has its own peculiar ideas about money makin') but a "Kreolite" Wood Block Floor is a "horse of a different color" . . . many printers and manufacturers have experienced the money making qualities of these floors. They assure a firm foundation for machines . . . resist and absorb terrific weights, pressures, blows, noise and vibration . . . thus providing a comfortable floor to work and walk on. Coated with "Kreolite Jennite" it is dust, skid and spark-proof . . . cooler in summer and warmer in winter.

A Kreolite Wood Block flooring expert will call at your request.

THE JENNISON-WRIGHT CORPORATION
TOLEDO 9, OHIO • *30 Nation-Wide Offices*



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1 Comfortable to work over . . . easy under foot.
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5 Assures firm foundation for machines.*
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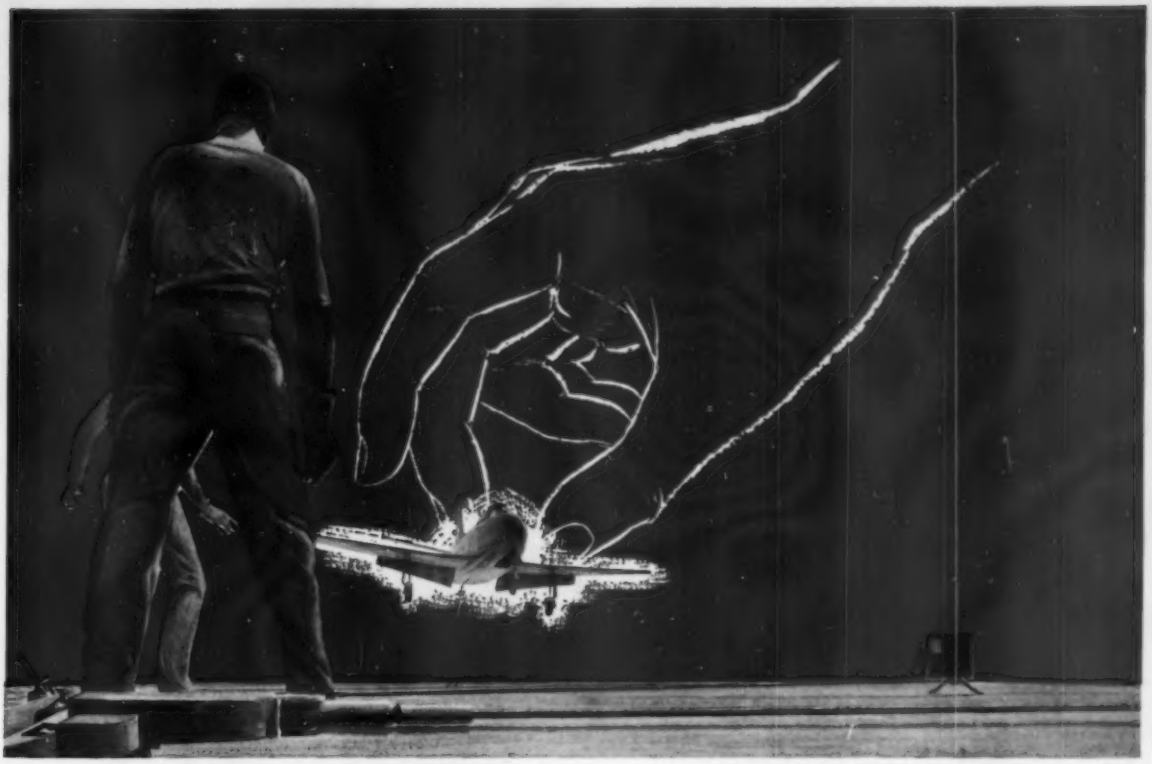

SAFETY FIRST . . . LAST and ALWAYS

thanks to modern catapults and arresting gear

Our Navy—the world's safest Navy—takes nothing for granted. On carriers both new and not so new, nothing—no, nothing—is spared to get its planes off and back home again—*safe*.

Powerful catapults give heavy craft a whip-fast, thoroughly sure shoveoff. And firm but gentle arresting gear make possible quick-on-a-dime stops when they come home to roost.

Bliss personnel are now working hand in hand with Navy officials in the development and servicing of modern catapults and arresting gear. They are also proud to be a major producer of the modern steam catapult.

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MACHINE GUNS • NAVAL GUN MOUNTS • SPECIAL MACHINERY

now you can get a finish

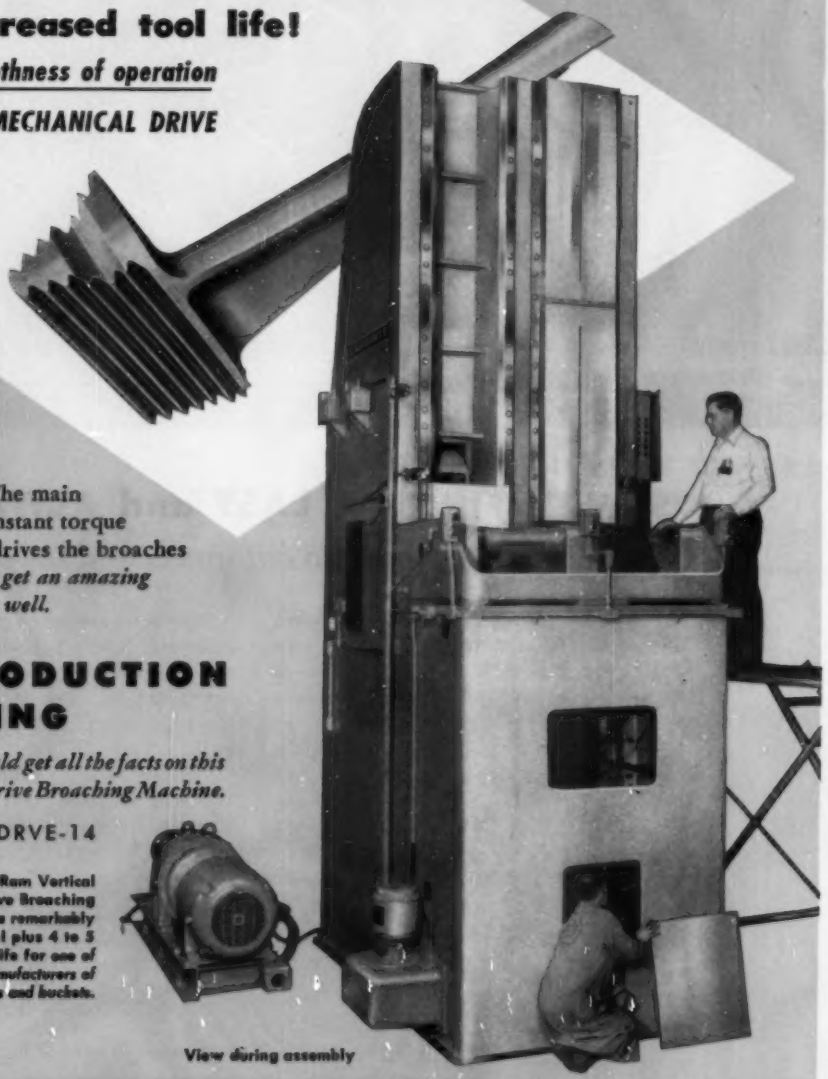
by LAPOINTE BROACHING

far superior to any finish ever before obtainable . . .

and 400% increased tool life!

The reason? . . . smoothness of operation

through the ELECTRO-MECHANICAL DRIVE



This machine is massive, weighing something over 30 tons without tools. Slides are unusually heavy. The main drive gear, powered by a constant torque variable speed D.C. Motor, drives the broaches so smoothly that *you not only get an amazing finish but increased tool life as well.*

for HIGH PRODUCTION BROACHING

of these and other parts, you should get all the facts on this newest LAPOINTE Electric Drive Broaching Machine.

WRITE FOR BULLETIN DRVE-14

This LAPOINTE Double Ram Vertical *Electro-Mechanical Drive* Broaching Machine is producing a remarkably fine finish on S 816 steel plus 4 to 5 times greater tool life for one of *the largest manufacturers of* jet blades and buckets.

View during assembly

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FOR AUTOMOTIVE COMPONENTS

Because of long experience, serving many customers,

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to any specific project in the design and manufacture of automotive components.

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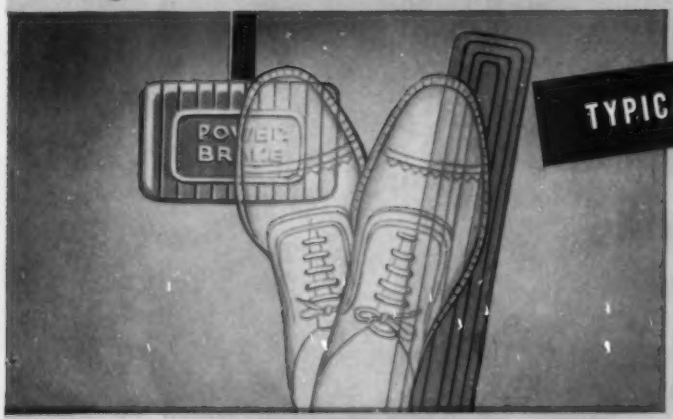

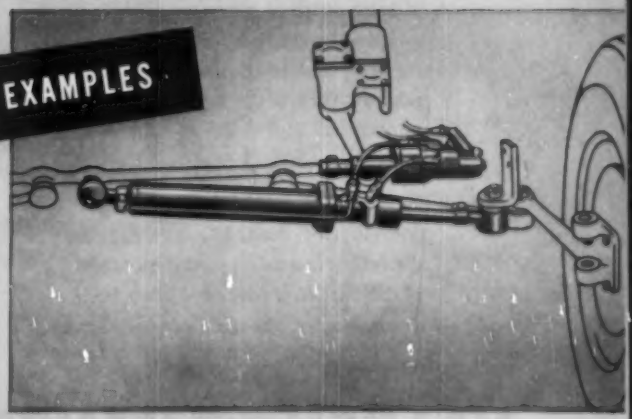

BENDIX LOW PEDAL POWER BRAKE—Specified by more car manufacturers than any other make, Bendix* Low Pedal Power Brake makes possible quick, sure stops by merely pivoting the foot from the go to the stop control. No need to lift the foot and exert leg power to bring the car to a stop. Result—more driving comfort, less fatigue and greater safety!

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We are proud of the continuing contribution made through the years to the motoring safety and dependability of the cars that roll on wheels by the *Kelsey-Hayes Wheel Co., Detroit 32, Mich.*

KELSEY-HAYES

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Over 7000 processing answers recorded for future reference.

pre-testing provides answers to processing problems

Whether you want to improve your present processing methods or to find the most effective method for new and untried processes, the safest procedure is to process a quantity of the product and observe results. And you can readily do this pre-testing in our Pilot Plant . . . an important part of the Blaw-Knox Research and Testing Laboratories.

Tests range from a few beakers of precious chemicals and antibiotics to tank cars of material requiring round-the-clock operation on a production scale. The data obtained from this pre-testing has resulted in the right answer to more than 7000 processing problems in the chemical, food, pharmaceutical and similar industries.

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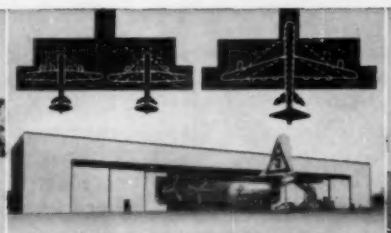
During the last ten years, nearly 500 Luria aircraft installations have been made. The United States Air Force has standardized on 14 Luria designs . . . and uses a wide variety of other Luria hangars. At Lockheed Aircraft, Luria structures cover over a million square feet. Among the hundreds of other Luria installations are hangars and buildings for the airfields of Turkey, Iran and Argentina . . . for many air lines including Pan American, United, American, Eastern, Northwest and Capital . . . and for many airports including New York International, Detroit Wayne Major, Springfield, Illinois and Westchester County, New York.

A PARTIAL SHOWING OF STRUCTURES FOR EVERY TYPE OF MILITARY AND COMMERCIAL AVIATION

STANDARDIZED HANGARS — both girder and truss types for commercial and military aircraft.



ALL-PURPOSE "WING" HANGAR accommodates one heavy aircraft or two medium aircraft.

DOUBLE CANTILEVER hangar for double-apron air traffic. Accommodates aircraft of all sizes.

AIRPORT TERMINAL shows how effectively Luria steel buildings can be adapted to airport needs.

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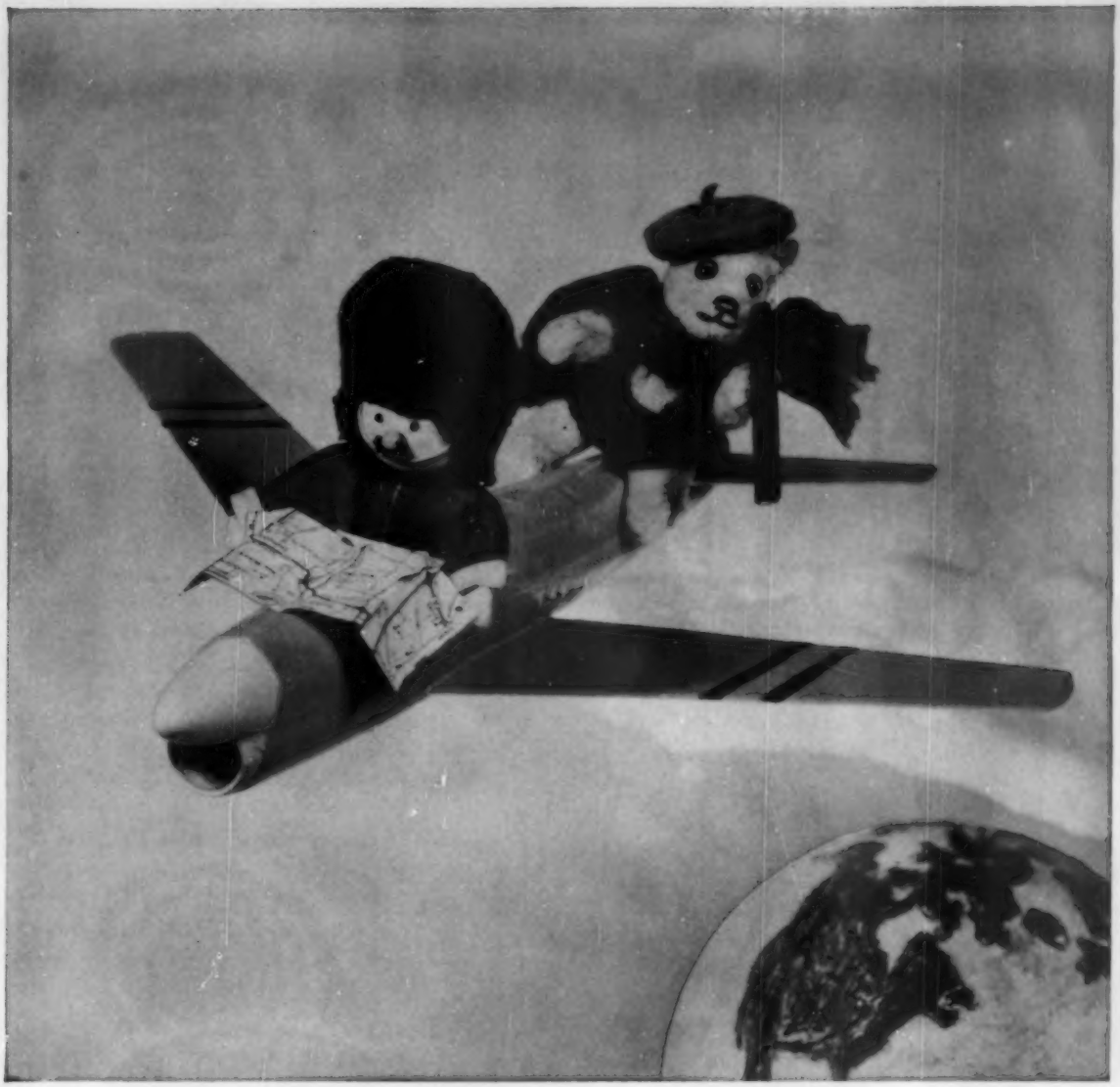

about aerial navigation

. . . AND FORD INSTRUMENT COMPANY

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New computers and instruments developed by the engineers of Ford Instrument Company have been solving the problems of modern plane navigation as well as guidance of pilotless missiles. Compact, light, accurate and dependable, Ford systems are helping our airmen maintain supremacy in the air. Design and production of precision equipment is a Ford specialty.

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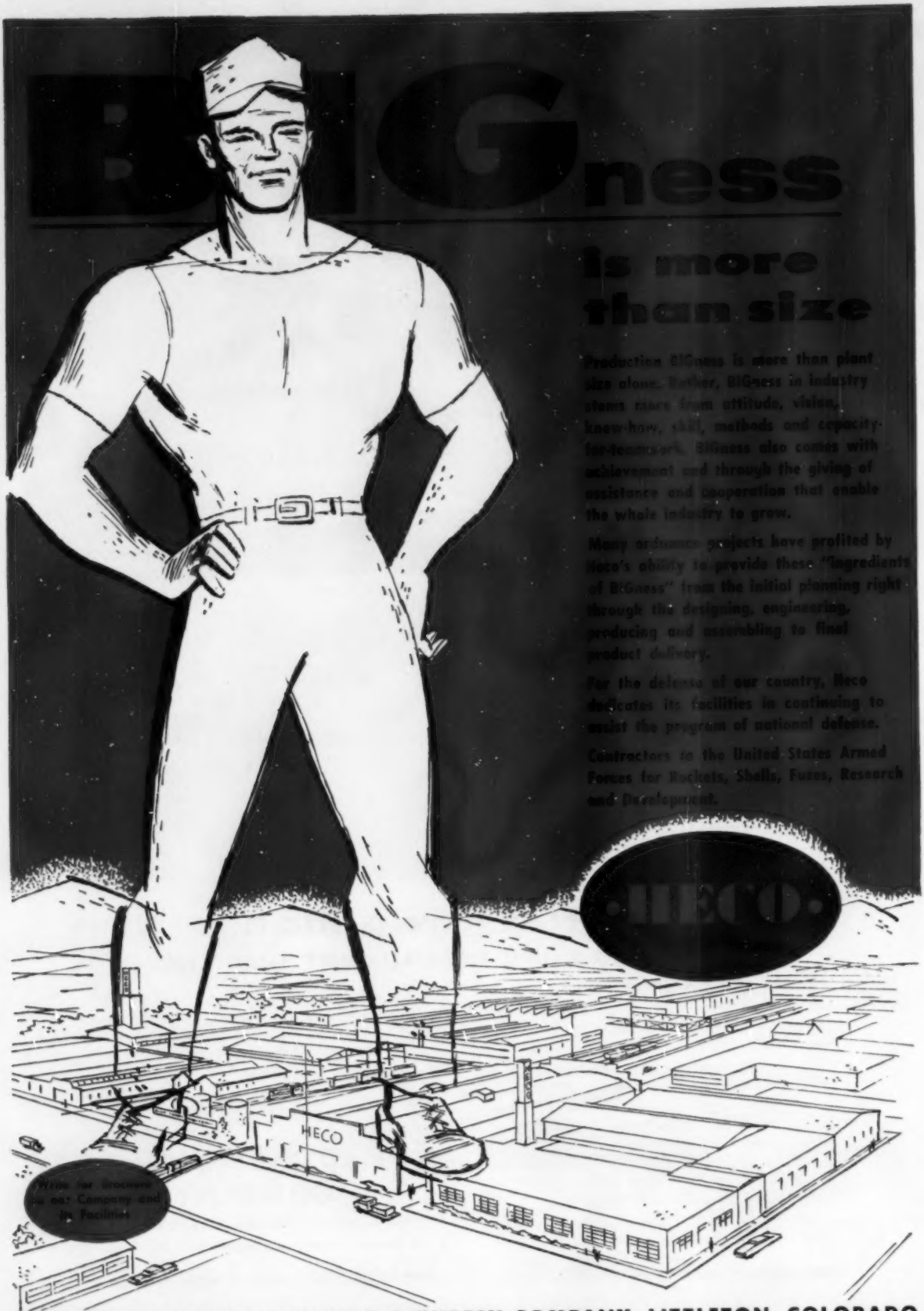
BIGness
is more than size
Production BIGness is more than plant size alone. Rather, BIGness in industry stems more from attitude, vision, know-how, skill, methods and capacity-for-teamwork. BIGness also comes with achievement and through the giving of assistance and cooperation that enable the whole industry to grow.
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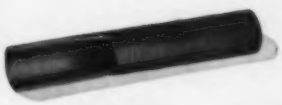

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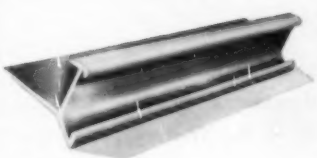

. . . made under strictest quality control to customer print.

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DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

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OAKITE RUSTRIPPER

for ALKALINE de-rusting of precision parts

Another new Oakite material for you – Oakite RUSTRIPPER. It's specially designed for alkaline de-rusting of precision parts where dimensional change and acid embrittlement must be avoided.

In addition to removing rust and heat scale from ferrous metals, Oakite RUSTRIPPER proves effective in some cases, for descaling heat-treated titanium.

Oakite RUSTRIPPER is a heavy-duty powder type compound that may be used hot or cold. It may also be used with direct current to remove deep-pitted rust or with reverse current to remove heat scale.

Oakite RUSTRIPPER does not contain cyanide and may be disposed of in the same manner as any highly alkaline solution. Cyanide, however, may be added should the need arise.

If you would like to know more about Oakite RUSTRIPPER or would like a demonstration without obligation write Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

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Oakite **RUSTRIPPER** will not attack sound metal

Oakite **RUSTRIPPER** will not cause hydrogen embrittlement

Oakite **RUSTRIPPER** needs no special stainless steel equipment

Oakite **RUSTRIPPER** gives off no troublesome fumes

Oakite **RUSTRIPPER** strips some paints as it de-rusts

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Gulf Oil gives 7 reasons why **ALUMINUM PAINT** is used at its Port Arthur Refinery

Aluminum paint has been in continuous use since 1925 at Gulf Oil Corporation's Port Arthur, Texas, Refinery. A two-year field test at that time, and subsequent tests, prompted Gulf to adopt aluminum paint as a standard finish for many of its tanks, towers, buildings, process units and overhead piping installations. Here's what the tests have shown:

1. Aluminum paint has unusual qualities of *durability*.
2. The "leafing" quality of aluminum paint provides an excellent *moisture seal* against the high humidity and rainfall of the area.
3. Aluminum paint is *economical*. Some applications have had a life as long as 8 years.
4. It provides a good heat reflective surface for tank roofs . . . helps to reduce stock losses caused by evaporation.
5. Its slick, hard surface resists soot and dirt, provides good *long-term appearance*.
6. Aluminum paint is *easy to apply, with high spreading rate*.
7. It has *excellent one-coat hiding power*.

ALCOA does not make paint, but Alcoa® Aluminum Pigments are used in more aluminum paints than any other brand. Special formulas have been developed by your paint manufacturer to solve individual problems. Paints made to these formulas actually cost you less, last longer, give utmost protection against heat, cold, sun, rain, smoke and fumes. Write us today for FREE BOOKLET, *Painting With Aluminum.*

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Please send me your FREE BOOKLET, *Painting With Aluminum.* I plan to paint

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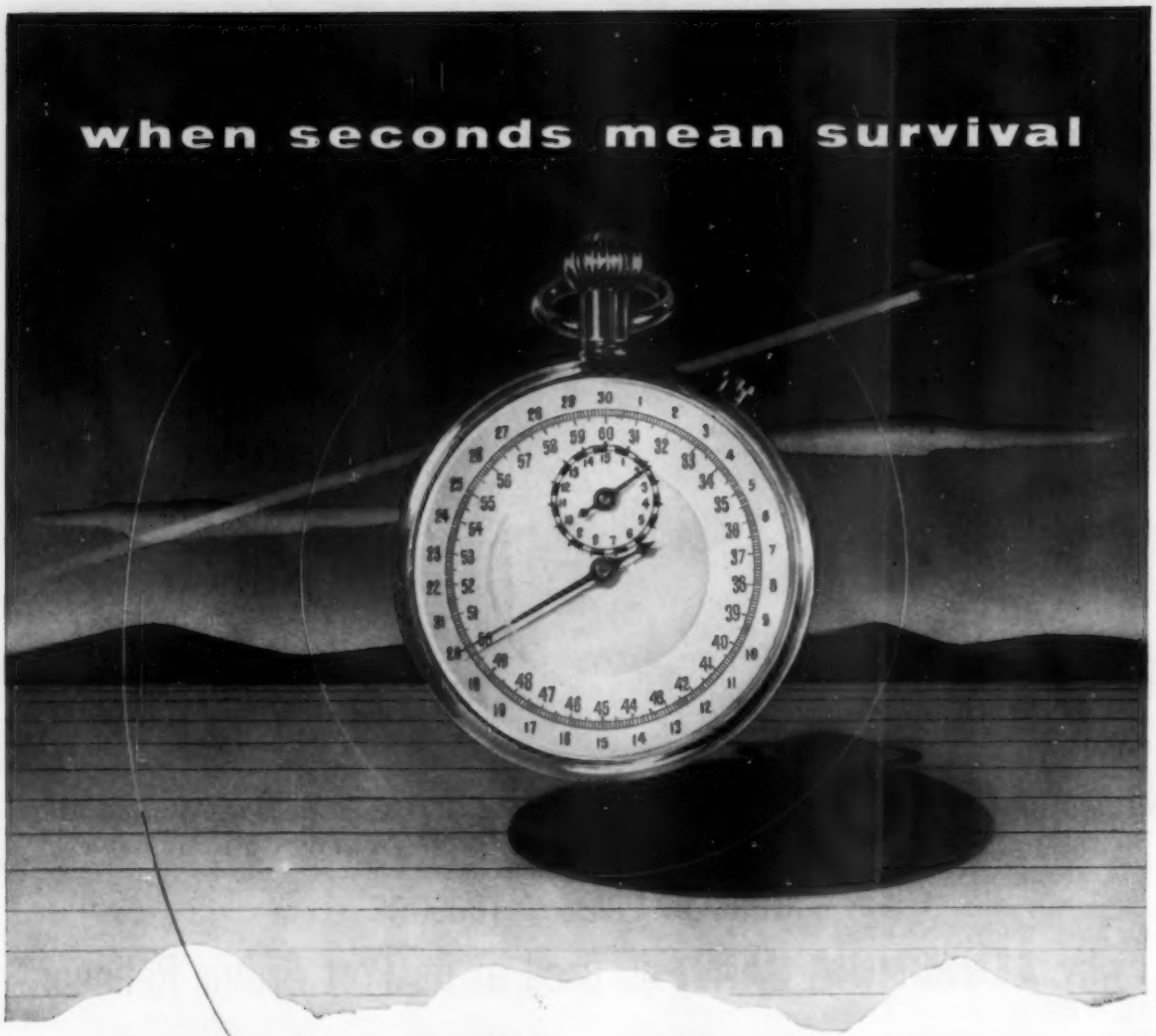
when seconds mean survival



Ground support equipment of unquestionable reliability is the indispensable factor for maintaining aircraft at a constant "ready" . . . and getting them airborne in the shortest possible time should the need arise. ▷ To this vital end CONSOLIDATED devotes its full resources and long experience as the established pioneer in the design, development and manufacture of GROUND SUPPORT EQUIPMENT. ▷ Typical of CONSOLIDATED'S important contributions is the versatile, highly efficient MA-1 self-propelled multi-purpose power unit. ▷ It is the ONLY GROUND SUPPORT VEHICLE which meets all the complex problems of towing, testing, servicing and starting jet aircraft . . . quickly and surely . . . even under the most difficult operational conditions. Now serving the U. S. Air Force, Navy and Marines . . . this sturdy unit is CONSOLIDATED for GREATER POWER and VERSATILITY.

THE ALL-PURPOSE MA-1 HELPS GREATLY TO SOLVE THE MANPOWER PROBLEM . . . FOR ONE SERVICEMAN TAKES THE PLACE OF FOUR

IN THE EXACTING FIELD OF GROUND SUPPORT, CONSOLIDATED HAS DEMONSTRATED ITS ABILITY TO MEET THE MOST COMPLEX DEMANDS

CONSOLIDATED
DIESEL ELECTRIC CORPORATION

STAMFORD, CONN. BRANCHES · DALLAS, TEX. · DAYTON, OHIO · SANTA ANA, CAL · WASHINGTON, D. C.

when seconds mean survival...

MODEL MA-1

GROUND SUPPORT

This compact, self-propelled, multi-purpose unit performs all requirements of towing, testing, servicing and starting for jet aircraft

- A. C. POWER... 30 KVA, 400 cycles, 3 phase and 10 KW 1 phase, close regulated.
- D. C. POWER... 28.5 volts, up to 2250 AMP. For split or single bus start and servicing.
- COMPRESSOR... Air supply up to 3500 psi, 13.5 CFM, 1,000 cu. in. reservoir.
- TOWING... All-wheel drive Torque converter transmission—for smooth, more dependable towing.

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ATOMIC ENERGY

"ATOMIC RUBBER"

A new process of utilizing atomic energy to vulcanize rubber has been developed by the Air Research and Development Command. Perfected by ARDC's Wright Air Development Center, the new process uses gamma radiation in place of conventional chemical and heat-treating methods.

Discovery of the process followed ARDC's attempts to vulcanize an experimental rubber. When conventional methods failed, it was decided to attempt a gamma-radiation method, among others. Subsequent investigation of all available natural and synthetic rubber compounds revealed that the gamma-radiation technique produced vulcanization equal or superior to that achieved by conventional methods. No residual radiation has been detected in the compounds vulcanized by the gamma method.

By utilizing controlled dosages with the various types of materials subjected to the novel treatment, it has been found that fillers and other additive substances used for compounding purposes impart beneficial properties to the cured elastomers. In general, the intensity of the gamma radiation, from a cobalt 60 source, governs the degree of vulcanization in terms of time of exposure and type of rubber.

Not required with the new method is the need to add chemical vulcanizing agents, such as sulphur, sulphur derivatives, and metallic oxides during the milling process of rubber production. Also not required is the heat-treating used to achieve vulcanization with conventional methods.

At present the new method seems most promising for vulcanizing rubber for specialized uses, such as producing high-temperature, oil-resistant rubber compounds and for improving the low-temperature serviceability of rubber.

ENERGY FOR INDUSTRY

Two products of atomic fission—heat and radiation—are the principal applications of this new power expected to make major contributions to industry, medicine, and science, according to Dr. Chauncey Starr, manager of North American Aviation's nuclear engineering and manufacturing operation, speaking before the Business Outlook Conference in Los Angeles.

"Because of our great industrial experience with the conversion of conventional fuels by chemical combusion into heat, and then into electrical and mechanical work, the most obvious application of atomic energy is as a substitute power source," Dr. Starr stated. "In its most concentrated form—an atomic explosion—we have a military weapon. In its most conventional form—a controlled energy release—we have a power plant."

Since the electrical power requirements of our country are doubling about every ten years, within about twenty-five years we will be tapping more marginal and more costly reserves of coal, gas, and oil, and in about fifty years the cost of these conventional fuels will move sharply upward. In contrast with conventional fuel supplies, Dr. Starr noted the huge availability of fissionable materials (uranium and thorium) and an expected decreasing cost of power from atomic plants.

ATOMIC POWER RACE

"We have in this country a technology and industrial capability that is unsurpassed," according to Thomas E. Murray, Atomic Energy Commissioner, speaking before the international convention of United Steelworkers of America, Atlantic City, N. J. "We have a wealth of courageous nuclear scientists, so indispensable and always so willing to assist once the need is made clear. Because of the magnitude of the job ahead, we should immediately increase the number of scientists presently engaged in atomic power work.

"Our failure to go ahead on a broad, vigorous program will be interpreted as a 'dog-in-the-manger' policy," Mr. Murray said. "It would be like saying, 'We could have atomic electric power if we wanted it; but, unlike the rest of the world, we do not need it today. Therefore, its development can wait for economic and financial forces to move it ahead.'

"That is an attitude which must be resisted. To permit such a policy to prevail because of budgetary or other limitations would be inconsistent with all that this Nation stands for. It would play into the hands of the Soviets. No one familiar with world technology has any doubt that today the Soviets are capable of meeting the atomic electric power challenge. The explosion of a hydrogen device by the Soviets in August 1953 and other evidences of their over-all nuclear progress are clear indications of their ability in the atomic field.

"If the U.S.S.R. should win the industrial power race, the price tag for nuclear power reactors will be high. So high indeed that the purchaser will be forced to relinquish his birthrights and civil liberties in exchange for nuclear electric power. This must not happen. What a tragedy it would be if world leadership

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in this field fell by default into Soviet hands."

NUCLEAR REACTORS

"There are so many diverse types of reactors that could be built for the purpose of developing electrical energy from nuclear fuels that the Commission was faced with the necessity of selecting the few most promising ones," according to Lewis L. Strauss, Chairman of the Atomic Energy Commission, speaking before the New England Council, Boston, Mass. "In this way a concentrated effort could be made along specific lines.

"Such selection generated the now well known 5-year reactor development program. This program, at a total cost of about $200,000,000, provides for the completion of five reactors at the rate of one reactor a year, each representing a different approach to the goal of obtaining economical electric power.

"In September the President broke ground at Shippingport, Pa., for the Nation's first full-scale nuclear power plant. This reactor, known as the 'pressurized water reactor,' is expected to be supplying at least 60,000 kilowatts of electricity to the Pittsburgh area by 1957. The design was selected as the first of those in the 5-year program because its technology was the most advanced.

"Although some consider it to be the least likely, of the five selected, to produce economical power, it will surely provide much of the experience and information necessary to make later reactors economically successful. . . .

"The other power reactors in the 5-year program are the 'sodium graphite reactor,' which uses sodium as the coolant and heat-transfer medium and graphite as the moderator; the 'boiling water reactor,' which will provide steam directly to the turbines which turn the generators, thus saving the intermediate step of transferring heat from the coolant; the 'fast breeder reactor,' which will not only produce power but will also produce more fuel than it burns; and the 'homogeneous reactor,' which has the advantages of simple design, low-cost chemical processing, and no fuel elements to fabricate or handle.

"Of course, even though our maximum effort is being put into the 5-year program, our people have not completely buried themselves in it to the exclusion of other ideas. New technology is being uncovered and developed every day, and we are keeping alert for new discoveries, and our program will remain flexible.

"Many other reactor concepts, such as the liquid metal fuel reactor and the gas coolant reactor, have their advocates and warrant investigation. And besides all this we are pressing ahead with vigorous programs developing specialized power reactors to propel ships and aircraft for the armed forces."

AMERICAN ORDNANCE ASSOCIATION

Founded 1919

A patriotic, educational, scientific, nonpolitical, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense

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VICE ADM. GEORGE F. HUSSEY, JR.
President, American Ordnance Association

Preparedness Leadership

American Armament Supremacy—Army, Navy, Air Force

A warm and heartfelt welcome to Vice Adm. George F. Hussey, Jr., as President of the American Ordnance Association!

Distinguished as the World War II Chief of the Navy Bureau of Ordnance and as the present managing director of the American Standards Association, he carries forward, into a challenging new era, the magnificent tradition of inspired and dedicated leadership of his A.O.A. predecessors in office.

It is an odd fact that, while nearly every one has opinions about the general topic of leadership, there is little popular consensus about what leadership is or what it should be. The conflicting assumptions held by the man in the street have their counterpart among persons who have attempted to understand the phenomena of leadership in more scientific terms.

Is leadership a property of a group or is it a combination of the characteristics of an individual and historical circumstances—the right man at the right time?

THE record of our national-defense program during the past thirty-five years clearly indicates that the American Ordnance Association has possessed leadership ability in an eminent degree. Intelligence, technical skill, dependability, vision, perseverance, coöperation, flexibility, devotion to country—these and a host of other fine qualities have marked the ever-increasing growth and importance of the Association during the past three somber decades.

During this critical period in our national history, A.O.A. members have never missed an opportunity for national service or by-passed a difficult scientific or technological problem. On the contrary, they have responded with consummate ability to every demand made upon them.

They have demonstrated for all the world to see the vigor, competence, and effectiveness of our democratic system in a period of unparalleled anxiety and peril. The American Ordnance Association is truly a leadership group.

In saluting Admiral Hussey, we would also like to pay grateful tribute to Lieut. Gen. Levin H. Campbell, former president of the Association, who manifested at all times those exceptional qualities of leadership which are enthusiastically recognized and honored by all.

Admiral Hussey is a worthy successor to General Campbell under whose dynamic leadership the Association has reached a new plateau of membership, has achieved sound financial strength, and has conquered new peaks in Post activities and in Technical Division and Committee accomplishments.

AT the conclusion of his 2-year term of office, General Campbell informed the membership at the Thirty-sixth Annual Industrial Preparedness Dinner Meeting in New York last December that he did not wish to be considered for renomination.

While appreciating such honor deeply, he felt with equal fervor that the presidency of the Association should be rotated every two years among members who are predominantly identified with the Army, Navy, and Air Force.

As a former Chief of Ordnance of the Army, General Campbell felt that his successor should be one who has been identified with naval ordnance activities and he, in turn, at the end of two years, by one who has been similarly identified with the Air Force. He further explained that he hoped such representatives of the services would not always be retired officers but also men from industry and science whose principal distinction was in the field of that particular service.

It is the Association's good fortune to have Admiral Hussey, a leaders' leader, at the helm, ably assisted by an outstanding group of officers, directors, and advisers (see p. 703) for the next twenty-four months. Anchors aweigh!

Vice Adm. George Frederick Hussey, Jr., was born in Brookline, Mass. Upon graduation with distinction from the U. S. Naval Academy in 1916, he served in many billets at sea in battleships, destroyers, and mine craft. From 1939 to 1941 he commanded Destroyer Division 24 and then Mine Squadron 3 until April 1942, during the latter part of which he commanded the Offshore Patrol at Pearl Harbor.

Ashore he served in many Naval ordnance activities including the Naval Proving Ground and the Bureau of Ordnance. In September 1943 he was appointed Assistant Chief and in December the Chief of the Bureau of Ordnance which he directed for the last part of World War II and until he retired in 1947.

Since 1948 Admiral Hussey has been managing director and secretary of the American Standards Association—a federation of technical societies and associations serving as the national clearinghouse for standards, and this country's representative body for internationalization of standards.

Admiral Hussey has been closely associated with the American Ordnance Association for many years, serving as president of the New York Post, 1950-1954, and a national director since 1954. He is president of the United States Naval Academy Alumni Association. His home is in Norwalk, Conn.

Continental Air Defense

Radar networks, ground observers, interceptor aircraft, antiaircraft guns and rockets, and intelligence squadrons are now organized under one command to protect America from any hostile attack from the skies

Gen. B. W. Chidlaw

General Childlaw is commander in chief, Continental Air Defense Command, Ent Air Force Base, Colorado Springs, Colo.

TOO few persons realize it yet, but America has entered into a new way of life. For the first time in nearly a century, United States' homes are threatened directly by the scourge of war, and we must learn to live with this threat for it promises to be with us indefinitely.

Living with it means a number of things. For many communities, it means the acceptance of military personnel for their protection as more and more radar, jet interceptor, and Nike guided missiles are created.

What is that threat and what is being done to counter it?

The greatest threat today to the physical security of the United States is the combination of the Soviet Union's long-range air force and her stockpile of weapons of mass destruction.

This gives her the capability—perhaps not the intention, because nobody seems to have been able to figure the intentions of Communist Russia very accurately until it's too late—it gives her the capability of launching an air attack of tremendous proportions against this country.

The only true effective countermeasure to this threat is to prevent war itself. Toward this end the United States has been building and maintaining a whiplash capability of its own. This capability is our own strategic arm, with its heavy bombers of intercontinental air endurance which permit it to reach targets anywhere in the world and return to its own or friendly bases.

There certainly is an element of extreme discomfort to the Soviet Union in this. Yet there may be a factor which gives them an element of comfort, too.

Their comfort is our intentions. They know we do not intend to use our striking capability unless we are forced to do so. We thus afford them an initial advantage over us because of our national sense of morality—and our national tradition for never having struck a first blow.

But we believe the very existence of our capability for promptly crushing the sources of aggression against us—represented by our strategic striking forces—has served and continues to serve to prevent the outbreak of a major war. In the opinion of many, this deterrent actually constitutes the balance of power between the free and the Communist worlds.

We must consider our striking force as both offensive and defensive in character. On the one hand it utilizes the only means of going promptly and directly to the enemy's heartland for decision and ultimate victory by assuming the offensive. On the other, it undertakes a most effective defense against air attack by destruction of enemy air forces at the source—in his homeland.

However—through desperation, through miscalculation, through misreading of the contrived intelligence of Communism—the Soviet Union might suddenly decide to team up the hard-charging horsepower of its atomic capability with the intention of raining destruction upon us and strike with little or no warning.

Against this possibility the United States has had to present a complementary arresting device to the offensive capability and become strong enough defensively to protect the American homeland—working against the shock effects of any possible air attack of a sneak and surprise nature.

TO make our forces adequate to counter the Russian threat requires the coördinated effort of all of us—both military and civilian. Today, wars are fought by the people as a whole—not merely by military forces. Civil-defense programs must go hand in hand with the military programs.

Functionally, the performance of the air-defense mission requires the participation of many agencies: (1) The Air Force provides the basic organization, detection, and interception forces; (2) the Army provides antiaircraft artillery units; and (3) the Navy and Marine Corps provide forces as required.

These military forces are under the control of a joint commander and are subject to joint doctrines and procedures approved by the Joint Chiefs of Staff.

Last, but certainly not least, is the participation and coöperation of various civil agencies.

Our operations are divided into four distinct phases: detection, identification, interception, and destruction. A description of these functions gives a concise and comprehensive picture of the goal and workings of the air-defense system.

For detection, our defense system relies mainly on radar and the voluntary services of the Ground Observer Corps. The construction of a main control and warning radar installation in the continental United States and the populated part of Canada has been completed. Its deployment was based upon many factors including location of likely critical targets, probable enemy routes of approach, and terrain features.

We are building as rapidly as we can, within the framework of men and material allotted, a warning system that can give us time—time to detect intruders bent on destruction and shoot them down before they are upon us and time to get our offensive striking forces on the way to their retaliation targets.

It is very fortunate that Canada is with us heart and soul in the air defense of the North American continent. It is with her coöperation that our mutual plans for a warning system well up toward the Arctic Circle are proceeding as rapidly as we can push them.

When this system becomes a fact, it should give us what the enemy does not want us to have—time to detect his intentions and time to mount a rebuttal.

Coastal picket ships operated by the Navy presently are providing seaward radar surveillance off both coasts.

ACTUALLY, the Continental Air Defense Command has plans for several hundred new radar sites, including a chain of so-called "Texas towers" or sea platforms extending 125 miles off the east coast from Norfolk to Newfoundland.

These latter will give an extra margin of protection against seaward attack, adding to the Navy's radar picket ships and the radar-crammed Lockheed RC 121 Constellation patrol aircraft soon to be fanning out over the Atlantic as they now reconnoiter the Pacific.

In addition to the established lines, the radar-detection capability in Alaska and Greenland is of immense value to the continental air defense system as well as for local air defense in those areas.

Another integral part of the existing detection system is the Ground Observer Corps. This system is organized into areas, each served by a filter center, requiring approximately 12,000 civilian volunteers to man both the posts and the filter centers.

Currently there are 49 filter centers, some 16,000 observer posts, and over 380,000 civilian volunteers in the system. CONAD expects to have 73 filter centers, 24,000 observer posts, and over a million volunteer spotters by 1956. It is anticipated that eventually there will be an observer post for every eight square miles of geography within the United States.

Ground observers in this system keep a lookout for aircraft flights and report them to the filter center. Volunteer workers in the filter center receive these reports, plot the information on a grid map, evaluate it, and when definite paths of unidentified aircraft have been established, report them to an Air Defense Direction Center. The ADDC will, in turn, take action to intercept and identify these aircraft.

Each filter center is manned permanently with a military detachment of officers and airmen, having a dual operational and training mission. Mobile training teams are organized and equipped to train the supervisory personnel of the observation posts. In addition, the detachment must train volunteers to operate each filter center.

The Ground Observer Corps is in many instances the only means available to permit detection of low-flying aircraft, and its efficiency in this mission is in direct proportion to the manning achieved, the incentive provided to the volunteers, and the amount of training that can be given.

The second function, that of identification, is probably the most difficult because of the tremendous amount of air traffic in the United States today. The only effective solution at this time is strict control of air traffic in order to avoid saturation of the identification system which involves the matching of flight plans with radar tracks.

The first step in the identification system is the identification of aircraft penetrating the borders of the country, and certain critical interior areas. CONAD, in conjunction with the Civil Aëronautics Administration, established certain areas which are called Air Defense Identification Zones (ADIZ).

THREE types of ADIZ were initially envisioned and subsequently established. Each of these has rules and regulations to be observed by aircraft operating in these areas. They include an international boundary ADIZ along the U. S.-Canadian border, coastal ADIZ's along the Atlantic and Pacific Coasts, and domestic ADIZ's around critical target areas within the United States. Flights inside internal Air Defense Identification Zones below 4,000 feet do not require flight plans.

The establishment of the lower limit of 4,000 feet in internal zones resulted from the large number of small aircraft operating at low altitudes, lack of communication facilities, and inadequate radar coverage at low altitudes. The 24-hour operation of the Ground Observer Corps is a major step toward eliminating the 4,000 feet of free space.

To perform the function of interception, we have fast jet all-weather fighter interceptors designed for the air-defense mission capable of interception and destruction of the target while flying on instruments.

When aircraft under observation cannot readily be identified by other means, these fighters are "scrambled" to intercept the unknown aircraft and visually inspect it to determine its identity. These interceptions are being performed daily by North American F-86D Sabrejets, along with Northrop F-89D Scorpions and Lockheed F-94C Starfires.

The present fighter force demands the utmost efficiency in its utilization for air defense. Any increase in the capability of target detection, tracking, and identification will result in a directly proportional increase in the ef-

ficiency of utilization of the fighter force available.

Fighters of other Air Force commands and of the Navy are available to the Continental Air Defense Command for emergency use. These would augment CONAD's fighter force to a considerable degree, if the demands of their primary mission and warning time will permit. Many Air National Guard units are now available to CONAD as a combat force augmentation, though, again, we would need advance warning for their effective employment.

DURING an emergency, the Navy commander at CONAD will be able to bring into the picture naval aircraft and naval air stations. Aircraft carriers might be used effectively, too. Although the carrier is essentially an offensive weapon, its ability to lauch jet fighters far off the Nation's shores and intercept incoming raids before they can reach our borders might prove invaluable in keeping the battle away from the continental United States itself.

The final phase of the four basic actions is destruction. The destruction of an enemy bomber is a function of either the armament of the interceptor or the fire from Army antiaircraft batteries.

In the past few years interceptor tactics changed due to the use of aircraft with a new fire-control system and the use of aërial rockets. This change of fighter tactics, with improved armament, gives to the fighter a definite advantage over the bomber.

The newest production version of the Scorpion, for example, is armed with 104 air-to-air rockets and is our most heavily armed fighter a rplane. Designated the F-89D, this rocket-armed model of the Scorpion carries its giant punch in its wing-tip pods. These airplanes are now on round-the-clock duty with squadrons of the Continental Air Defense Command.

The Army Antiaircraft Command supports the Continental Air Defense Command by providing final rings of defense against any enemy aircraft penetrating the screen of fighter-interceptors which would go out to meet the attacking bombers. In short, the Army has joined with the Air Force to develop what might be likened to a defense in depth.

The antiaircraft defense of the United States against air attack is, in fact, one of the Army's major responsibilities. Most defended zones are heavily populated or industrial areas. Many large cities do not have antiaircraft defenses at the present time. The Army—like the Air Force—can stretch a defense dollar only so far, and there simply are not enough guns and men to go around.

In this field the development of the first operational antiaircraft guided missile, the Nike, was a great stride forward. The formation of Nike battalions and the movement of these battalions to on-site locations in the United States is progressing steadily.

For use against aircraft flying at low and medium altitudes, the antiaircraft troops have a new cannon—the Skysweeper. It is electronically controlled and tracks the target automatically while firing 75-mm. shells at a rapid rate. These two new weapons supplement the old stand-bys of antiaircraft artillery—the 90-mm. and the 120-mm. guns.

TURNING to operations, the geographical subdivision of responsibilities of the Continental Air Defense Command Headquarters at Colorado Springs breaks down the country into three regions, each the responsibility of an air defense force: the Joint Eastern Air Defense Force Headquarters at Stewart Air Force Base near Newburgh, N. Y.; the Joint Central Air Defense Force Headquarters at Grandview, Mo.; and the Joint Western Air Defense Headquarters at Hamilton Air Force Base, just north of San Francisco.

Each region is divided into sectors and is the responsibility of an Air Defense division which has direct operational control of all surveillance units and weapons allotted to the sector.

The divisions perform and supervise all measures necessary for adequate air defense—including the operation of radars and fighters, allocation of forces, implementation of security-control plans, and activation of warning networks.

Finally, within the Continental Air Defense Structure are the Air Defense Direction Centers which are strategically located within the Air Division areas.

The Air Defense Direction Center is the radar facility from which the air battle is fought—where fighters are scrambled and controlled to their targets. From these centers come the operational information on hostile aircraft around which the entire air-defense mission is predicated.

Although remote from Air Defense Command Headquarters in terms of organizational structure, the ADDC commander has full authority to order fighters into action whenever he deems it necessary.

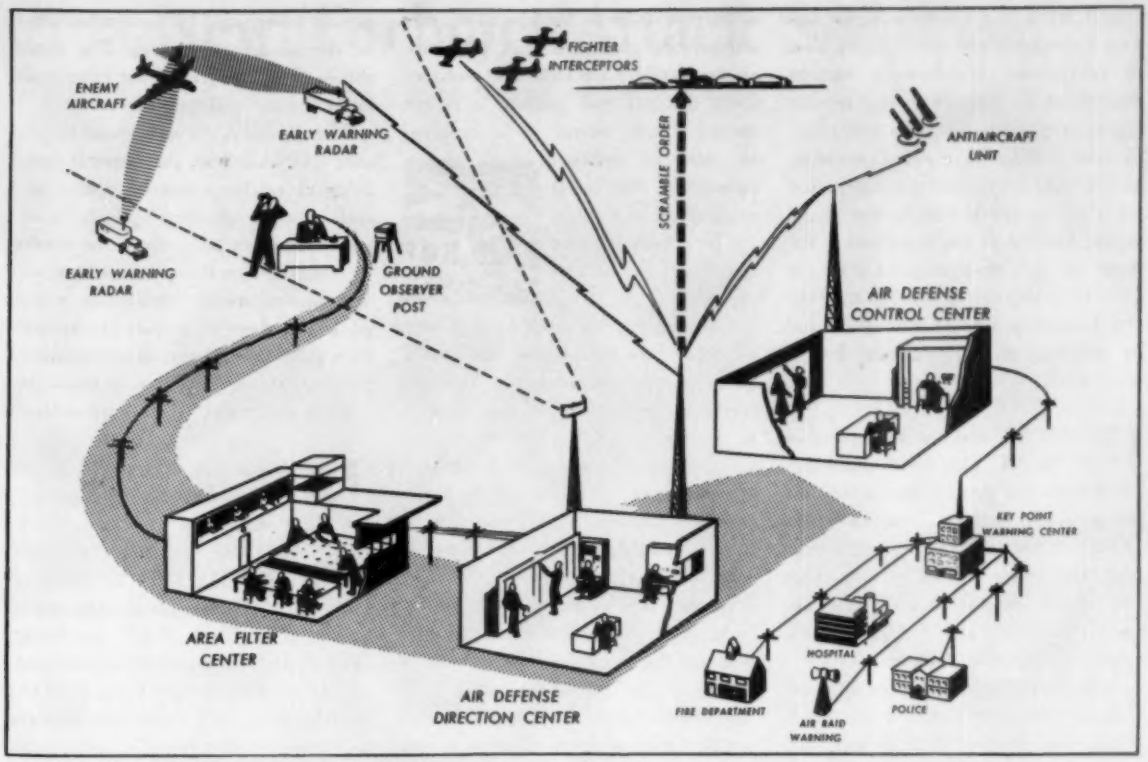
At these centers and at outlying locations, radar sets and ground observers scan the skies continually, observing all aircraft which pass within their range.

Daily the Direction Centers fulfill their many functions. At the first appearance of a pip on the radar screen, flight records are checked to ascertain whether the airplanes were friendly or unknown. Finding them to be unknown, the Direction Center commander then orders our interceptors into action for purposes of identification.

If the unknown aircraft are determined to be hostile, the order would then be given to attack. Once aloft, the interceptors are guided by the radar sets of the Direction Center which then are serving as control devices—directing the interceptors toward the enemy aircraft.

As soon as the enemy or an unidentified aircraft is picked up by radar, a report is sent to an Air Defense Control Center which is set up on Air Division level to supervise and coördinate the air-defense functions carried on by several Direction Centers within the sector.

RADAR is not in use at the Division Control Center. Unlike the Direction Center, where all aircraft are observed and tracked, the Control Center collects and displays only the information on unknown or hostile aircraft and friendly interceptors.



A simplified diagram of air-defense operations planned to detect and intercept potential enemy aircraft.

Air-defense information is also forwarded to the air-defense forces, each force plotting and recording all the information within its sector of responsibility.

The organization of CONAD and its operational concepts and functions have been based on the supposition that simultaneous, widely diversified air attacks can be directed against any or all of the major targets within the United States at any given time.

TO counter this possible scheme of attack, and to minimize the inherent advantages of surprise, alerting procedures and communications systems capable of passing warnings throughout the U. S. in a matter of minutes have been established.

The Air Defense Control Center (ADCC) announces the condition of air-defense warning over a special civil warning net simultaneously at all civil key-point air-defense warning centers within each Air Division. Each State has one or more of these key points. Dissemination beyond the key point is in accordance with procedures established by State or local civil-defense agencies. The entire system, embracing some 160 key points, is operational at all times.

A similar but separate warning system has been established for the notification of key military installations. For general use, three conditions of air-defense warning, descriptive of the air situation, exist: Red, Yellow, and White.

The broad definitions of these conditions of air-defense warning are as follows: Warning Red, attack by hostile aircraft is imminent; warning Yellow, attack by hostile aircraft is probable; warning White, attack by hostile aircraft is improbable (all clear).

An additional condition of warning, but applicable to the active Air Defense system, is Air Defense Readiness. It is a means of placing all forces available for air defense at maximum immediate operational capability. It is initiated normally as a result of suspicious patterns or actions of incoming unidentified aircraft or the evaluation of current intelligence which indicates the need for extraprecautionary measures.

If a tense military situation should develop prior to actual hostile attacks, there is the authority to declare a "military emergency," and the various echelons of the Continental Air Defense Command will further disseminate the fact that a military emergency exists and will simultaneously announce a warning White to certain agencies.

In addition to placing forces available for air defense at maximum sustained combat potential, this will be the signal to initiate certain actions, one of which is the security control of air traffic. The warning White will remain in effect as long as a military emergency or condition of war exists, except during periods when warning Red or warning Yellow are in effect. As for the general public, the warning White is tantamount to the "all clear" signal.

WARNING Yellow is disseminated to military and key civil agencies but not to the general public. Warning Red, however, is announced to the general public after it has been passed over the civil and military warning nets.

In the event of an air attack on the

United States, the Continental Air Defense Command will immediately alert all commercial broadcasting stations throughout the country to stop regular broadcast and to go on a controlled frequency designed to avoid providing navigational aid to enemy bombers and yet give maximum information to the public. Control of the broadcasting stations in an emergency, known as CONELRAD, will be through the Federal Communications Commission and by authority of a Presidential Executive Order.

CONAD will also put into operation the "SCAT" plan which establishes procedures and general instructions for the security control of civil and nontactical military air traffic during a military emergency which will provide maximum utilization of aircraft and airspace by military and civil agencies engaged in essential operations.

The intermingling of friendly unknown tracks and hostile tracks which would exist without these security control measures would create a very undesirable, if not impossible, identification situation.

Another problem greatly affecting the need for security control of air traffic in all the areas of the continental United States during a military emergency is the employment of automatic and radar air-defense weapons. Modern all-weather interceptors, guided missiles, and antiaircraft artillery are radar and electronically directed and guided. It is not necessary, nor should it be required in time of military emergency, that visual recognition of the target be obtained before the weapon is employed.

To complete the air-defense picture, CONAD has the 4602nd Air Intelligence Service Squardon for the rapid wartime exploitation and field analysis of downed enemy equipment and uniformed personnel within the boundaries of the country. Detachments or flights of the squardon are strategically located throughout the United States to carry out this vital mission.

In the event of an air attack on the continental United States, it can be anticipated that a considerable number of enemy aircraft will be downed by U. S. fighter-interceptor action, by antiaircraft artillery damage, by exhaustion of fuel, or by mechanical failure. The enemy aircraft, the aircrewmen, and the documents in the aircraft or in possession of the aircrewmen, represent significant sources of intelligence information.

This information can be of inestimable value in the conduct of air defense operations but only if it is collected and rapidly transmitted to the combat units of the air-defense system. The faster this is done, the greater the value realized; minutes will count.

The 4602nd AISS was created to provide CONAD with the physical capability of reaching downed enemy aircraft or crew members quickly in order to conduct and report the results of immediate on-the-spot investigations and interrogations. Intelligence teams of the squadron are prepared to traverse all types of terrain regardless of weather, by land, air, or parachute, to reach the scene of the crash of any enemy aircraft.

THUS we are building up our air-defense system. While we are improving the system, it is in effect twenty-four hours a day. Our pilots are ready at a split second's notice to climb in their aircraft and take off. And while the pilots are ready, airmen are sitting before radar scopes, scanning electronically the probable routes which an enemy bombing raid might take, soldiers are standing alert by their antiaircraft guns and guided missiles, and men of the Navy are aboard radar picket vessels off our shores.

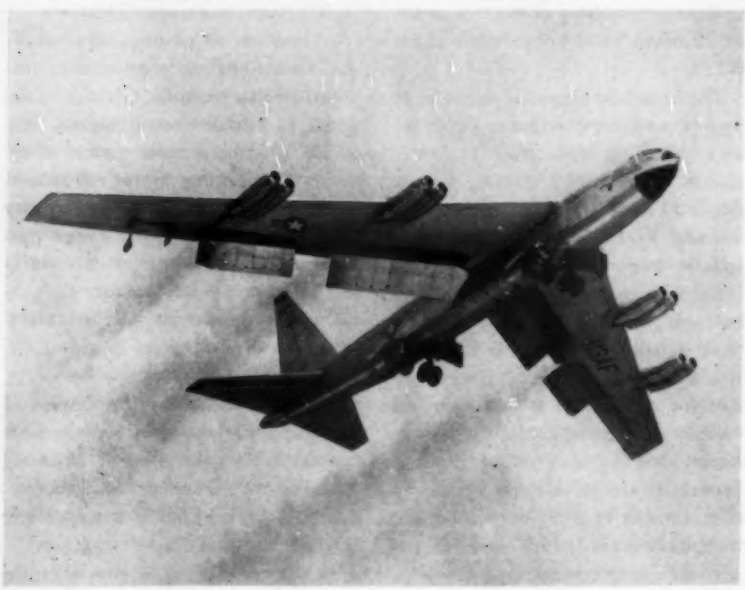
The pilot in a California scramble hut and a radar operator sitting before his scope in Maine or a ground observer on a deer ranch in Wisconsin are not merely three separate Americans hundreds of miles apart. They are members of an organization bound together under the gravity of one of the most urgent responsibilities ever to face this Nation.

This responsibility is air defense. In an age where the shattering fury of atomic attack could swing from potentiality to reality on a given word, there is no room for a "sometimes" defense. There is no slack season, no off-market in the business of air defense.

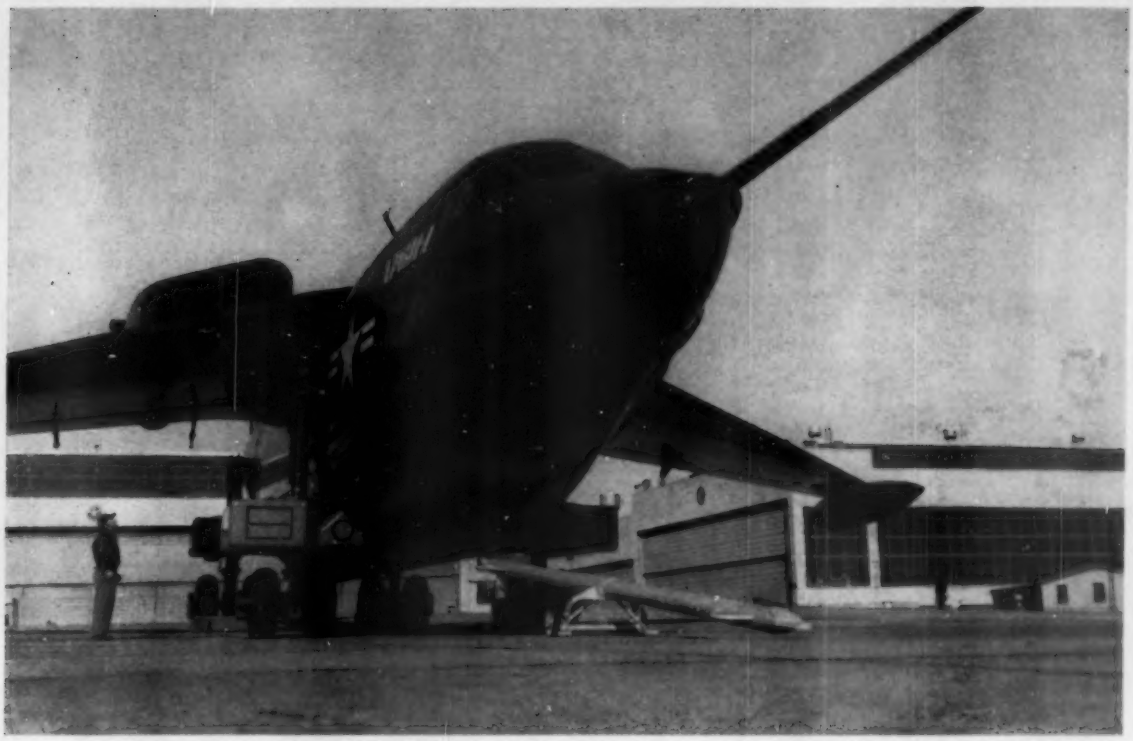
If we are to protect this Nation from the devastation of an atomic Pearl Harbor, we must force strength and vigilance into our framework of defense. We must be a constant force, resolutely guarding every minute of every day, whether it be the still of 3 a.m. or the rush of high noon.

The Continental Air Defense Command is building to protect that constant force.

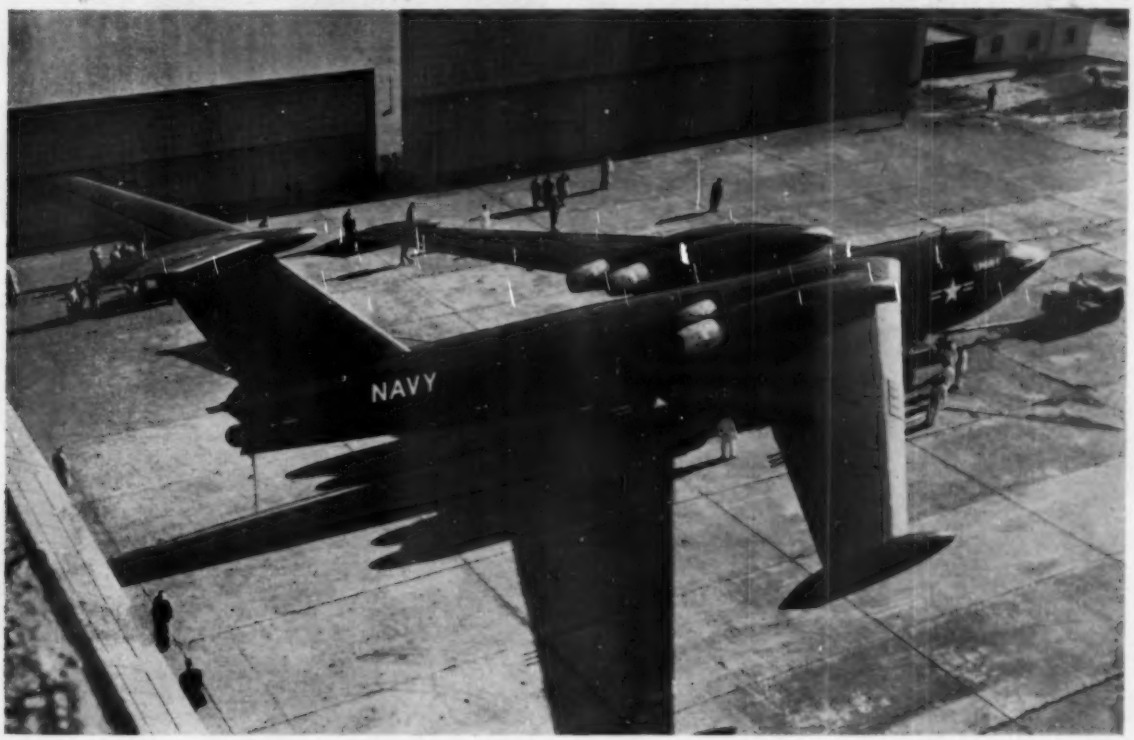
The 8-jet Boeing B-52 Stratofortress long-range bomber (Air Force photo).



New Turbojet Attack Seaplane



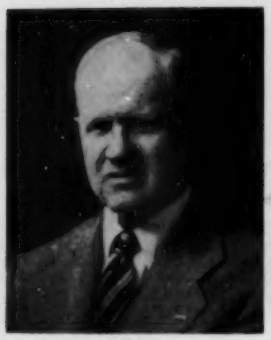
The Navy's recently unveiled Martin XP6M-1 Seamaster attack seaplane, shown above and below on its beaching gear, is a mine-laying and reconnaissance craft capable of operation in high seas. Its four turbojet engines give it a speed of over 600 m.p.h. while it can carry a 30,000-pound payload and cruise at 40,000 feet. It will spearhead the new Seaplane Striking Force.



Officers and Directors of the

Vice Adm. George F. Hussey, Jr., a former Chief of the Navy Bureau of Ordnance and now managing director of the American Standards Association, was elected president of the American Ordnance Association for a term of two years beginning January 1, 1955. The election was held at the annual meeting of the Board of Directors of the A.O.A. in New York City, December 1, 1954.

Admiral Hussey succeeds Lieut. Gen. Levin H. Campbell, Jr., who held the office with distinction since 1953. General Campbell is chairman of the Board of the Automotive Safety Foundation.



George F. Hussey, Jr.
President, New York, N. Y.

Levin H. Campbell, Jr.
Past President and Director, Washington, D. C.

Harvey C. Knowles
Vice-President, Cincinnati, Ohio

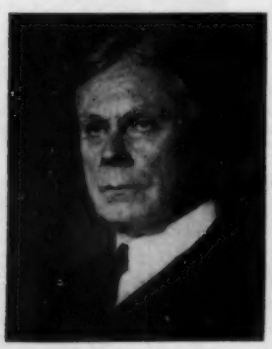
Louis Polk
Vice-President, Dayton, Ohio

K. T. Norris
Regional Vice-President, Los Angeles, Calif.

John M. Olin
Regional Vice-President, New York, N. Y.

John S. Pfeil
Regional Vice-President, Boston, Mass.

Paul Pigott
Regional Vice-President, Seattle, Wash.



John Ross Delafield
Counsel, New York, N. Y.

John F. Floberg
Assistant Counsel, Washington, D. C.

Henry N. Marsh
General Chairman, Technical Divisions and Committees, Wilmington, Del.

Leo A. Codd
Executive Vice-President, Washington, D. C.

The Board also elected Stanley C. Hope, president of the Esso Standard Oil Company and a director of the A.O.A., to be a vice-president of the Association succeeding Col. Herbert A. Gidney. General Campbell and Colonel Gidney both continue as directors of the Association.

Admiral Hussey became Chief of the Bureau of Ordnance in 1943 after serving at sea in battleships and destroyers and ashore in ordnance billets at the Bureau and the Naval Proving Ground, Dahlgren, Va. After his retirement in 1947 he became managing director and secretary of the American Standards Association.

Robert L. Biggers
Vice-President, Detroit, Mich.

Stanley C. Hope
Vice-President, New York, N. Y.

Daniel J. Martin
Regional Vice-President, Houston, Tex.

Carl S. Hallauer
Regional Vice-President, Rochester, N. Y.

William J. Rushton
Regional Vice-President, Birmingham, Ala.

Charles M. White
Regional Vice-President, Cleveland, Ohio

Dean Witter
Regional Vice-President, San Francisco, Calif.

James D. McIntyre
Treasurer, Washington, D. C.

Herbert A. Gidney
Director, Pittsburgh, Pa.

Donald F. Carpenter
Director, Wilmington, Del.

Henry L. Clark
Director, South Gate, Calif.

W. W. Coleman
Director, Milwaukee, Wis.

Directors and Advisory Board

The Board of Directors is the governing body of the Association. It elects an Executive Committee and an Advisory Board and appoints the national officers of the Association. The Board meets at least once during the year. The Executive Committee, appointed from among its members, conducts the business of the Association between meetings.

The function of the Advisory Board of the Association is to counsel and advise the Board of Directors on matters of broad policy affecting the A.O.A. At the Directors' meeting on December 1, 1954, the following were added to the membership of the Advisory Board of the Association:

Paul L. Davies
Director, San Jose, Calif.

B. F. Fairless
Director, Pittsburgh, Pa.

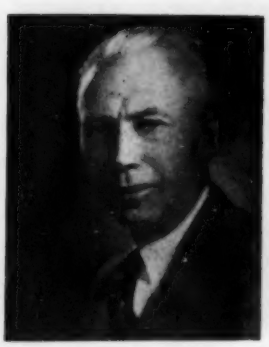
R. E. Gillmor
Director, New York, N. Y.

C. Jared Ingersoll
Director, Philadelphia, Pa.

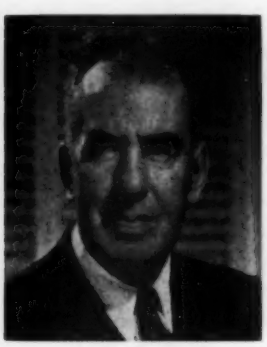
J. E. Trainer
Director, Akron, Ohio

Charles D. Wiman
Director, Moline, Ill.

Donald Armstrong
Advisory Board, Washington, D. C.



Myron J. Hayes
Advisory Board, Rochester, N. Y.



A. W. Herrington
Advisory Board, Indianapolis, Ind.

H. P. Lawrence
Advisory Board, Seattle, Wash.

Fairman B. Lee
Advisory Board, Seattle, Wash.

American Ordnance Association

E. R. Godfrey, General Motors Corporation, Detroit, Mich.; Myron J. Hayes, Eastman Kodak Company, Rochester, N. Y.; Fairman B. Lee, Fairman B. Lee Company, Seattle, Wash.; John Slezak, Turner Brass Works, Sycamore, Ill., who recently retired as Under Secretary of the Army.

These and all the officials of the American Ordnance Association, leaders in their respective fields, have given unstintingly of their time and energy to make the A.O.A. what it has become today—a leader in the cause of Peace through Preparedness.

K. T. Keller
Director, Detroit, Mich.

Ben Moreell
Director, Pittsburgh, Pa.

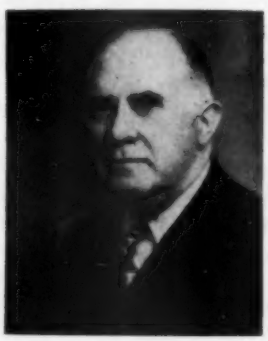
Frederick H. Payne
Director, Springfield, Mass.

S. E. Skinner
Director, Detroit, Mich.

Thomas F. Brown
Advisory Board, Delray Beach, Fla.

T. M. Girdler
Advisory Board, Cleveland, Ohio

E. R. Godfrey
Advisory Board, Detroit, Mich.



Thomas A. Morgan
Advisory Board, New York, N. Y.

John Slezak
Advisory Board, Sycamore, Ill.

Lewis L. Strauss
Advisory Board, Washington, D. C.

Charles E. Wilson
Advisory Board, New York, N. Y.

Arms Vigilance for Peace

United States military policy in the atomic age must attempt to foster a healthy and expanding national economy while maintaining sufficient military strength to win any war that may be forced on us

Maj. Gen. James M. Gavin

SOME fifty years ago Sir Halford Mackinder delivered his first paper on the influence of geography upon political institutions and military affairs. His views ultimately were published in the book, "Democratic Ideals and Reality," whose main thesis, often quoted, was:

He who controls East Europe commands the Heartland;

He who controls the Heartland commands the World-Island;

He who controls the World-Island commands the World.

These lines, in brief, summarize Mackinder's views—views that were arrived at after a thorough study of the population, industrial capacity, and communication routes of the major land areas of the globe. They were undoubtedly valid based upon the conditions affecting these principal factors at that time.

Since then the peoples of the American Continent have increased, matured, and participated victoriously in two major global conflicts. In the last of these conflicts the United States was dubbed "the Arsenal of Democracy" in tribute to its great industrial capacity, production methods, and plentitude of resources.

IN the past fifty years the energetic, driving, imaginative, hardworking American people, the followers of the Western Star, have thrust out from their original settlements to the far reaches of the Pacific where they maintain in Korea a small bridgehead on Mackinder's World-Island. They and their allies occupy or control a chain of islands on the fringes of the World-Island, extending from the Aleutians through Japan, Okinawa, and Formosa to the cornerstone in the Philippines.

General Gavin is Assistant Chief of Staff, G-3, Operations, Department of the Army, Washington, D. C. This article is based on an address given by General Gavin before a recent meeting of the Michigan Post of the A.O.A. held at the Sheraton-Cadillac Hotel, Detroit, Mich.

Opposite the Philippines there is another Free World bridgehead on the World-Island: Southeast Asia. The Middle East is largely exposed, but the security forces of the Western Powers, extending from Norway through the Balkans to Turkey, form a protective wall between the European Peninsula and the remainder of the World-Island.

Mackinder emphasized the importance of communication routes in his World-Island. Using his original assumptions as appropriate for the present-day world, I have come to believe that there is in fact another World-Island—the Western Hemisphere. Many things have brought this about, and I have touched upon them lightly so far, but one major factor which Mackinder did not foresee has contributed to this: the airplane.

I want to call your attention to the military implications of this global situation. Here we have an American World-Island, bordered by broad oceans, containing a group of peoples whose institutions and, in many cases, whose military forces are in contact with those of the peoples dominating the Eurasian World-Island.

As we in North America look to the Peninsula of Europe, we are aware that our northern flank is bordered by an area hostile to land movement, an area of ice and snow, across which trans-World-Island travel cannot be accomplished save by air. The possibilities of air travel in this region have been dramatically demonstrated by the flight of the ROYAL VIKING on November 15, 1954, from Sweden to California.

You can therefore understand our preoccupation with the threat of air attack, since this is something readily feasible to a potential enemy. These circumstances place a great premium upon holding the fringes of the ice area. Both sides desire to push outposts as far into the Arctic as possible, since these outposts can give early warning of attack and provide some measure of opposition to an invading enemy air force.

Looking to the Peninsula of Europe we are aware that it is an area containing a population greater than that of the North American Continent, 305 million, compared with 227 million. It is an area rich in natural resources. For example, Western Europe produces more coal and iron than does the U.S.S.R. In fact, only in that vital war-making commodity—petroleum—does U.S.S.R. outproduce Western Europe.

In 1953 the estimated industrial production of Western Europe was valued at $70 billion, compared with $15 billion for that portion of Europe behind the Iron Curtain. These statistics make it strikingly clear that Western Europe is economically of great importance, not only to the Europeans but to us.

In addition, the ideological, sociological, and cultural associations of the Europeans are of such nature as to bring these people much closer to us than to the U.S.S.R. Militarily, they provide the balance of potential war power between the U. S. and the U.S.S.R., and our national strategy must clearly reflect our understanding of the need to protect Western Europe and retain it in the Western World.

Looking to the Pacific, we find the Japanese struggling to recover economically. They must be encouraged to defend themselves, but they cannot defend themselves effectively until their economy will support their defense necessities. Okinawa, Formosa, and the Philippines must be held beyond any doubt. The Philippines are a bastion of great strength in the Western Pacific area and will remain so for some time.

The Southeast Asian area contains millions of people who look to the Free World for help. They, too, must be assisted in their struggle for freedom in so far as we can possibly do so. The loss of Southeast Asia, with a penetration by the Communists into Indonesia, would have ominous overtones for the future of the Philippines.

Our outposts, now extending from Japan through the Philippines, are on the fringes of the area where our World-Island touches upon that of the Soviets. These outposts must be held.

SINCE the end of World War II the power potentials and political alignment of the nations of the world have undergone significant changes. The world now contains three distinct political groups—the power center of the Soviet bloc, the power center of the United States and its allies, and, finally, those neutral nations which prefer not to be aligned with either. Of all the powers which might have been considered great prior to World War II, the United States and the Soviet Union have emerged as the two great world powers today.

Since its origin in 1917, the Union of Soviet Socialist Republics has cherished the obsession of a Communist world, dominated by Soviet Russia. To achieve their aggressive ends, the rulers of the U.S.S.R. have adopted force as the ultimate arbiter of the affairs of men.

Their basic philosophy stands revealed on the historical record, by their willingness to demean their own people and to expend human lives on whatever scale is demanded, not only in war but even in time of peace.

So far, the Soviet Union has succeeded in spreading its influence to roughly one quarter of the world's land area. It has engulfed the nations of Poland, Czechoslovakia, Bulgaria, Rumania, Hungary, Albania, the Baltic States, and portions of Germany and Austria. In Asia, the Soviet sphere has extended its influence to Manchuria, China, North Korea, Mongolia, Tibet, and a portion of Indo-China, and is threatening additional areas in Southeast Asia.

In the military field, the Soviet Union has a land army of approximately 175 divisions and an air force of some 20,000 strategic and tactical aircraft. It is increasing its capabilities for the production and delivery of atomic and thermonuclear weapons to the point where it will, in the foreseeable future, reach a state of military parity with the United States.

To the Soviet divisional strength, satellites of Russia add approximately 70 divisions, and Communist China has more than 2,000,000 men under arms. The Soviet Navy continues to grow.

In evaluating the industrial strength which supports the Soviet military machine, we cannot afford for a moment to be complacent. All the available evidence indicates that, in military technology, the Soviets are formidable competitors. The performances at the last May Day air show in Moscow clearly demonstrated Soviet advances in the development of modern weapons, in helicopter lift, in highly mechanized and modernized land forces, and in medium and heavy bombers.

As a result of the continued increase in the components of Communist-bloc military strength, which has not been offset by any increase in over-all Allied strength, United States and free-world forces are being faced by Communist armies, navies, and air forces that are formidable in size, modern in material, and competitive in technique.

ADDED to this military strength there is an extensive apparatus in the form of the Communist parties and underground systems all over the world, dedicated to the overthrow of the governments of the free countries in which they are situated. The subversion, sabotage, and espionage stemming from those organizations can sap the strength and vigor of the most enlightened democracy.

Thus we see the Soviet Union opposing us with a combination of threats —political, economic, psychological, moral, and military. It challenges our economic system, and ridicules our political tenets; it rejects our spiritual creeds; it disregards the principles of right and wrong; it operates by pressures, subversion, and propaganda.

Soviet imperial planning is based on Communist power over a population exceeding 800 million people, dominating the Central Eurasian land mass from the Elbe to the Pacific. It threatens by land any one of approximately twenty nations in Europe, the Middle East, and Asia, and indirectly threatens the North American continent.

Having briefly assessed the threat from the Communist powers, and the position in which the U. S. finds itself, we must answer the question, "What course should be followed in the future?"

In so far as the United States has freedom to choose, there are many forms and degrees of action to take and many different courses to follow. I suppose we can agree that the U. S. course must fall between two radical extremes, neither of which would be acceptable.

The one extreme, as I see it, would be complete and abject surrender now,

today, relinquishing our national wealth, power, and independence, and our personal beliefs and freedoms, and acquiescing in the ultimate rôle of being a satellite of the U.S.S.R.

The other extreme would be for the United States to embark on a deliberate campaign against the U.S.S.R., instigating total war with all available weapons, no matter how terrible, and regardless of the results to civilization, including our own.

The United States rejects absolutely both of these extremes.

Delimited by those extremes, however, are almost innumerable courses of action, some naturally more acceptable than others.

Course Number 1: The U. S. could isolate and disarm itself by withdrawing from the United Nations, from all agreements and treaties with other nations, from all interests outside our own borders. In this course, defense might be ignored and armed forces disbanded. In the future, the United States might devote its attention exclusively to internal affairs, much, let us say, as Tibet did, perhaps engaging in limited trade with a few other nations or possibly engaging in no foreign trade at all.

Certainly, before setting out on such a course, we would insist on satisfactory answers to the questions: Is the United States self-sufficient? Would an unarmed, isolated United States be in any danger?

SUPPOSE the United States were to choose, instead, Course Number 2, in which foreign relations would be abandoned, but not defenses. In this course, the U. S. would attempt to transform itself into an impregnable bastion and to ring itself with defensive barriers. Our military strength would be exclusively defensive. Would we then be secure, isolated behind a purely defensive ring?

In another course, Number 3, the United States might concentrate on reaching a compromise among the many important factors to be considered, such as maintaining a healthy, expanding economy, maintaining common enterprise with our allies, and yet maintaining military strength sufficient to win any war that might be forced upon us.

The U. S. would maintain flexible, versatile military strength able to cope with the variety of both defensive and offensive situations which might arise —such as cold wars, limited wars, wars of covert or overt aggression, general wars in which nuclear weapons were not used, or total wars utilizing weapons of every description.

As part of this course, the United States would plan to share with its allies not only its wealth but also their hardships. Such a course would be admittedly costly, and the critical question to be asked about this course is obvious: What is the balance point between a healthy economy and adequate military strength?

In the next course, Number 4, the U. S. might develop military strength but against only one type of military threat and thus depend on defending itself with only one weapon or one type of force, such as nuclear weapons or missiles or armored divisions or long-range airplanes or submarines.

This course might be developed in a slightly different form; that is, the United States would help to furnish the weapons and machines, but the allies would have to furnish all the men. This is obviously a somewhat less expensive course, initially at least, but it has the obvious disadvantage of inflexibility. Critical to its success would be the ability to select the proper weapons systems to cope successfully with the enemy strategy, a strategy that is for him to choose.

Moreover, we should have to anticipate accurately the time at which to achieve a maximum state of readiness in order to avoid trying always to be ready and thus straining the Nation's economy to the breaking point.

THE United States, apparently, has a choice among many courses of action. In reality, however, the choice is not that wide. The alternatives which I have used as illustrations, and which border on the extremes, are only slightly less undesirable than the extremes themselves. In the light of what we know of the threat to the United States and our present position, we are not really free to choose such courses of action.

Therefore, without attempting to be arbitrary, and realizing that I may be oversimplifying, I will settle for some form of course Number 3; that is, for some compromise. I will accept not any compromise, but a reasonable one which affords the United States a chance to survive.

The Department of the Army is currently embarked on an intensive program of studies and tests that will ultimately lead to the establishment of forces tailored to fight successfully in an atomic war. For some years, now, the Department of the Army has been intensifying its efforts in the field of tactical atomic weapons and missiles.

THESE weapons, which are now either available or becoming available, represent tremendous increases in firepower. I refer, for example, to the 280-mm. atomic gun, the Honest John rocket, and the Corporal missile. Even though the 280 is in the field, we are continuously working on improving its range and performance. A more maneuverable version of the Honest John system is now under study.

In fact, in all our weapons systems, including the Corporal and the Nike, the Army's antiaircraft missile, that are now in the field, the Army foresaw the need and allowed for a substantial growth potential without changing the basic system concepts. By this method, we can keep pace with the ever-changing tactical requirements by capitalizing on system concepts which have been proved in the field.

In addition to the Corporal, which affords us a dependable medium-range missile with an atomic warhead, the Army is also testing the Redstone missile. Because of the dispersed and very deep nature of future battle areas, weapons of long range and higher yield are essential to future tactical success.

Combined with these weapons and of immediate concern to the ground soldier is the Nike. The Nike is effective against any type of aircraft, including jets. Because of the high cost entailed in destruction of great numbers of modern high-speed aircraft, how-

ever, the Army has simulated targets of extremely high speed, high maneuverability, and high altitude and has fired Nike successfully at these targets.

In this respect, Nike has entirely measured up to our expectations of its performance. Based on that performance to date, we are convinced that it is an effective weapon against modern aircraft and aircraft of the foreseeable future.

All this firepower presages a battlefield environment quite different in character from anything we have known in the past. Clearly in prospect is the need for great dispersion with a capacity to react to requirements of a given tactical situation which in turn implies the need for tactical mobility in all echelons of the Army.

Through the use of helicopters, convertiplanes, and light utility fixed-wing airplanes, the Army fully expects to achieve the necessary degree of tactical mobility and internal flexibility to fight in an atomic environment.

COMBINED with these great increases in firepower and mobility will be a need for improved communications and the use of television, radar, and additional electronic devices to assist the Army commander in acquiring intelligence and effectively committing and controlling the forces at his disposal.

There has been a hope in many quarters that with the advent of atomic weapons there would be a lesser need for what people like to call "conventional" forces. When atomic weapons were available to but one side in a conflict it seemed quite clear that they could, to a degree, replace conventional-type forces. But once they are available in significant numbers to both sides, the character of the equation changes completely.

To fight successfully under such conditions one needs considerable depth and extensive dispersion, plus all the resources to give one the mobility and communications necessary to fight effectively. There is no inexpensive way to survive in an atomic war, and there is no one weapons system that can do the job to the exclusion of all others.

Democracy is a flexible entity. Democracy today is far removed, both in concept and in practice, from what it was in the days of Thomas Jefferson. Its inherent flexibility has enabled it to meet the changing demands of time, however varied they may have been. It likewise must meet the challenges of tomorrow—and it will.

Any strategy designed to support it must also be flexible. Military power must be capable of carrying out the will of the people it represents—no more, no less. The Army exists to maintain the peace of the country in the same way that a policeman exists to maintain the peace of the community—by virtue of readiness and unquestioned ability to quell criminal outbreaks.

"In evaluating the industrial strength which supports the Soviet military machine, we cannot afford for a moment to be complacent. All the available evidence indicates that, in military technology, the Soviets are formidable competitors. The performances at the last May Day air show in Moscow clearly demonstrated Soviet advances in the development of modern weapons . . . in highly mechanized and modernized land forces, and in heavy bombers."

Military power of this kind is reassuring to the good members of the community and an impressive deterrent to the bad. Like the police power in a community, military power must be capable of application with reasonable discrimination.

Further, a sound military establishment must be capable of winning a war. In this day and age, this requires global readiness to move with power to an area of decision, and the inherent flexibility to meet the great variety of demands that may be made upon it, from small localized peripheral wars to global conflict.

And, finally, our military establishment, in winning a war, must be capable of achieving through its victory a better state of affairs than existed prior to the war. This principle was long ago expounded by Clausewitz. One fights a war to impose one's will upon an enemy and to achieve a better condition than the intolerable one that precipitated the war.

I have recently returned from 3 years of service in Europe, 1½ years in the Mediterranean, and 1½ years in Germany. During World War II, I spent three years in Europe. I know and can understand the deep apprehension felt by many Europeans today. They know that the control of their area by the U.S.S.R. would tip the balance between the U. S. and the U.S.S.R., and they look with a deep and abiding concern, that colors their every political and diplomatic action, to these great powers.

IT is their fear that any conflict between the U. S. and the U.S.S.R. may destroy the peoples of Europe. They are constantly reassured of the peaceful intent and purposes of the U.S.S.R. They also are assured that the forces of the U.S.S.R. are there to protect them and for no other purposes.

For psychological reasons, therefore, as well as military, the weapons system we develop in the critical days ahead must have the flexible character necessary to satisfy the needs of the Europeans for protection and security. We must protect rather than destroy, and in a full-scale war we must defend Western Europe with power applied with discrimination. What I have said about Europe applies equally well to Asia.

The military requirements of our national security can and will be best met when we are prepared to make the sacrifices necessary to provide forces of such character that they have the inherent ability and flexibility to support our democratic concepts. There is no inexpensive way to do so, and we must realize this now.

The question to be answered is, "What is the price of liberty?" Having created such a security establishment as I have described we can speak in the world councils from strength, speak softly, speak quietly with the confidence born of strength. Thus will a free world be assured and those who aspire to freedom be given confidence and hope. Thus will we best serve the needs of our national security.

Evolution of the Torpedo

The development of this important naval weapon from its beginnings as a free-drifting explosive charge to the deadly high-speed, long-range, and accurate underwater missile now used by the United States

E. M. Seifert

A standard definition of a torpedo generally accepted today to include all types is: "A small crewless undersea craft, self-propelled and self-steered in both azimuth and depth, carrying an explosive charge which is arranged to detonate in contact with or in the proper proximity of its target."

In the language of the nineteenth century such a device would have been designated an automobile (*i.e.*, self-propelled) fish (*i.e.*, underwater-running) torpedo, but this being the only type now extant, the qualifying words "automobile" and "fish" have been dropped.

Until the latter part of the nineteenth century, "torpedo" seems to have been applied to any explosive charge, complete with detonating feature, prepared in advance and transported to the site of its intended use where it might be hidden either on land or under water, or hurled (as from a battlement), or otherwise transported or propelled, to explode upon contact with a solid object.

Thus the torpedoes damned by Farragut at Mobile Bay were such charges, encased in iron, strapped to the tops of submerged piles or, being buoyant, moored below the surface. In either case they were usually detonated when contacted by a vessel, although sometimes they were fired electrically or otherwise from the shore. Other contemporary "torpedoes" drifted either on the surface or below, from a buoy.

"Mine," more properly "explosive mine," appears to have originally inferred a subterranean passage, dug out by hand, terminating in a cavity containing explosive beneath an enemy strong point which was then suddenly demolished. Similarly, "countermining" was accomplished by the preparation of similar tunnels by the defenders, in which listening posts observed the operation of the hostile miners until they could be dealt with satisfactorily.

While the word "torpedo" has grown more and more narrow in scope of definition, "mine" has seemed to expand to accept the discarded categories.

The earliest known principles of mining were applied to marine warfare in 1585 when an Italian, Ferderigo Gianibelli, undertook to help the Dutch city of Antwerp, besieged by the Spaniards. The latter had built a fortified bridge across the Scheldt to stop the Dutch from running supplies into the city.

Gianibelli filled a small ship with gunpowder and sent it drifting down against the bridge, where a clockwork fuze exploded it, blowing up half the bridge and a thousand Spaniards. The explosion so frightened the Dutch themselves that they forgot to attack as planned, with the result that eventually the city fell anyway.

During the next 200 years the weakness of this type of military destruction —the explosion occurring above the surface instead of below, where its confinement would greatly increase the damage—was recognized, and spar torpedoes, both drifting and moored, were developed.

In 1622 a Hollander, Cornelix van Drobbel, built a submersible rowboat in which he once gave King James I of England a ride. In the American Revolution, David Bushnell, who had left Yale to become a captain in the Continental Army, made an egg-shaped submarine with which he intended to attach mines to the bottoms of hostile warships. It was driven under water by two screw propellers, one vertical and one horizontal, operated by cranks from inside.

ABOUT twenty years later Robert Fulton presented several schemes to France, Great Britain, and the United States of America for several types of torpedoes, including the drifting torpedo and the spar torpedo, which was later to prove very successful, but he received little encouragement and had meager success with his devices. By his torpedo operations during the War of 1812, however, he harrassed the ships in Long Island Sound so badly that they were often kept under way at night to avoid him.

In 1822, Henri Joseph Paixhans, general of artillery and inventor, in *Nouvelle Force Maritime,* Paris, may be

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credited with the first effort to produce a torpedo in the modern sense of which written record is known to exist, since he proposed, quoting from a translation of the above article, "to give to the torpedoes the form of a canoe, and to set them in motion by a sort of fuze of formidable dimensions. The regular direction of the movement was established by a simple keel . . . and a simple mechanism served to produce the inflammation of the gunpowder when striking the hostile craft . . . At the third experiment the canoe ran seventy toises in a straight line and with a rather great velocity."

PAIXHAN'S "toise" was 6½ feet. His "fuze" we would call a rocket. He relinquished his experiments to accompany Napoleon's ill-fated expedition to Russia.

What may be called the second epoch in the history of the torpedo began when Colonel Colt invented his submarine battery to explode a submerged charge of gunpowder electrically. The torpedoes resulting, while known as offensive (drifting) and defensive (moored) torpedoes, would today be called drifting and anchored mines.

However, in several European wars during the period prior to our Civil War, when such torpedoes were known to be in use or available for use, their moral effect was great.

The American Civil War brought out a rash of experiments in submarine and torpedo warfare. On the Confederate side Raines built a sausage-shaped iron craft called DAVID (after Goliath's antagonist) armed with a spar torpedo. This was a charge on the end of a long pole projecting from the bow, with a lanyard running back to the boat to set it off.

With this torpedo the DAVID one night dealt the stout NEW IRONSIDES a wallop that sent her to the yards for repairs, and the Confederacy set up a secret-weapons department that built a crank-operated submarine called HUNDLEY after its designer.

On trials, HUNDLEY sank five times, suffocating her crew each time, whence her designers concluded that she would be more successful as a surface torpedo boat. As a surface craft, she sank the Federal corvette HOUSATONIC—and also herself for the sixth and last time.

Our Civil War did, however, see the first successful use of torpedoes. This method of naval warfare was singularly adapted to the requirements of the Confederate States, particularly in the defense of the Mississippi River, and history records that the U.S.S. CAIRO, sunk in the Yazoo River in 1862, was the first vessel to be destroyed in actual warfare by a torpedo or mine used by hostile forces.

Use of torpedoes was indulged in by both sides despite the outbursts regarding their inhumanity, and they proved quite efficient—drifting, anchored, and spar types being then equally satisfactory and successful. The Federals had their greatest success with the spar torpedo when Cushing sank the Confederate ironclad ram ALBEMARLE with a spar torpedo mounted on a little steam launch.

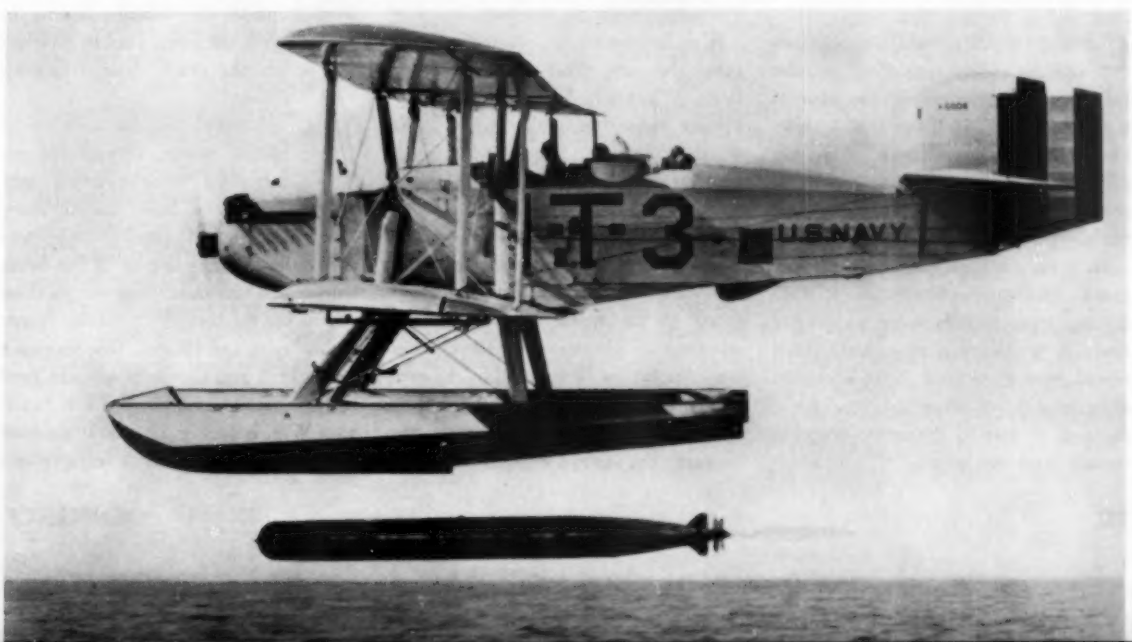
Although the spar torpedo was used in the Chilean-Peruvian war of 1879-1880, it soon went out of use because the development of quick-firing guns made it impossible for the torpedo boat to get close enough to its intended victim.

Experiments with torpedoes with fins, designed to be towed at an angle from the bow of a torpedo boat, like a modern paravane, were not very successful.

In 1864, under the stimulus of the Civil War, a small engine-driven boat with apparatus (not delineated) to steer a straight course to an enemy vessel was demonstrated by Messrs. Willoughby and Ramsey in the Potomac River, off Washington, D. C. The launch carried an explosive charge intended to be detonated on contact with the target, and the launch was powered by a petroleum-fired steam boiler and made an average speed of about four knots. It dragged two tiller lines behind, the lines paying out from two drums on the shore.

The application of a brake to either of these drums placed more pull on one tiller line than on the other and

A torpedo is successfully launched from a Navy biplane in tests of these underwater weapons in 1935 (Navy photo).



thus steered the launch much as a plow horse is guided.

The inventor and his backers, buoyed up by their results, proposed to the U. S. Congress:

1. With ten such launches, aided by the blockading fleet, it would be possible to clear the harbor of Charleston, S. C., of all obstacles, torpedoes, and Confederate rams.
2. With two or three clipper-built merchant ships, each carrying two or three such launches, we could clear the seas of all Confederate privateers.
3. With 200 of the launches, we could defend the port of New York against the combined navies of the World!

However, the pattern of the Civil War had been set by this time to the "power plays" of Grant and Sherman, and this development aborted.

The year 1864 also saw the beginning of the third epoch in the evolution of the present-day torpedo when it became (to quote Webster) a "dirigible, self-propelling, cigar-shaped, submarine vessel carrying an explosive charge and projected from a vessel against a vessel at a distance." Following the pattern thus far, it would appear that the story of the torpedo was an all-American saga and further development—at least drastic changes—would come from this country. Strangely enough, this final step was evolved in Austria by an army officer and actually exploited by an English company.

EARLY in the 1860's an Austrian artillery officer attached to the marine artillery conceived the idea of sending out a launch without a crew. He made some drawings of a big toy boat, to be driven by steam or hot air or even by clockwork, and steered from the shore with long ropes.

As it would have no crew, this boat could carry the explosives in its hull, having spars which were to project from it in all directions and which would serve to explode the boat's cargo of guncotton by firing a pistol into it as soon as one of the spars came in contact with the target.

Before he could carry out his ideas any further, this officer died and his plans were turned over to one Captain Lupuis of the Austrian Navy. After several years of diligent experimentation, Lupuis finally suggested a self-propelled torpedo driven by a reciprocating compressed-air engine to Robert Whitehead, a Scot, the manager of the Stabilimento Tecnico Fiumano in Fiume, Italy, who undertook further developments. These led to the Whitehead torpedo, the inspiration for all subsequent torpedoes and the prototype of all torpedoes not electrically propelled.

Mr. Whitehead's first torpedoes were cigar-shaped and built of steel, being approximately 11 feet long and 14 inches in diameter. The motive power was derived from the energy stored in compressed air at a pressure of about 700 pounds per square inch, the air chamber being of ordinary boiler plate.

The explosive charge was eighteen pounds of dynamite carried in the head which was secured to the forward end of the air flask. Abaft the air flask was secured the so-called afterbody containing the propelling and controlling mechanism.

The torpedo had only one propeller, and, to overcome the strong tendency to roll over and over (due to the small amount of statical stability), had long projecting fins at top and bottom running longitudinally. The entire torpedo weighed 300 pounds, was driven by a 40-horsepower "Brotherhood" engine at a speed of 6 knots for the "remarkable" range of 600 feet.

It is interesting to compare at this point this first effort with the latest Whitehead torpedo, following more than eighty years of development. The present torpedo is twice as long, weighs 10 times as much, carries approximately 20 times as much explosive for a distance 60 times greater at a speed approximately 6 to 8 times its former speed. In the matter of reliability and accuracy of performance, there is no way briefly to describe the improvements made.

Throughout its period of early production, the details of this invention were guarded with great secrecy. It was kept secret largely from commercial considerations, however, since the details could be purchased for a specified sum of money by any nation desiring to purchase the individual units. European nations were quick to grasp the opportunity to equip their navies with the Whitehead torpedo, as at that time they were considered absolutely supreme as an engine of naval warfare.

Immediately following the Whitehead development there came a period when torpedoes were invented almost daily, if various records and literature of the period (including patent applications) can be believed. Many of the devices were electrically driven and controlled with long cables to the power sources on shore or aboard ship. Others were driven by steam, carbon dioxide, or ammonia stored in the torpedo as liquids under pressure.

IN the light of our present knowledge, some of the problems which confronted these early torpedo engineers must have been extremely puzzling to them. In the cases of those torpedoes using reciprocating engines whose working fluids were carbon dioxide and ammonia vapor, the refrigerating effects must have been quite troublesome.

One inventor, who apparently encountered such effects when using carbon dioxide in this manner, promptly installed a preheater for his vapor coils by packing them in unslaked lime, above which was suspended sulphuric acid and water in separate containers.

At the proper time these containers were emptied, the mixture coming in contact with the lime, thereby producing the much desired heating effects.

Another torpedo used for its motive power compressed air furnished by the firing ship through a hose trailing from the torpedo. Still another type was driven by a steam engine in the firing ship which unwound wire wrapped on drums on the torpedo propeller shafts.

One type, the Howell, first proposed about 1868 and later adopted and used by our Navy during the Spanish-American War, is worthy of special mention because of its mechanical features and

the perfection of design. Its motive power was furnished by a 130-pound cast-steel or cast-iron flywheel, so designed as to have a maximum moment of inertia, which was spun up to several thousand revolutions a minute prior to launching by means of a steam turbine attached to the tube which was disengaged just prior to launching.

The wheel, through gearing, drove two propellers mounted as twin screws, which were of variable pitch and so designed that as the wheel speed decreased, the propeller pitch was automatically changed to maintain a constant torpedo speed through the water. It had depth control by means of a spring-loaded hydrodiaphragm and utilized the roll tendency occasioned by the gyroscope action of its prime mover, when its spin axis was disturbed by lateral deviation, to maintain the initial course.

OUT of all the ideas which were conceived during this 20-year period after the Civil War there were but two types of torpedoes which were adopted for our service: the Howell torpedo and the Whitehead torpedo—the latter alone remaining in the field shortly after 1898. In fact, in 1900 the only successful automobile torpedo in the world was the Whitehead, it being the common weapon of all nations which would buy it.

With the exception of many detailed improvements, it is the same today in general principle as it was in 1900. It is still the torpedo of the nations, except the United States, and may properly be termed the master torpedo as even ours is really an outgrowth of the Whitehead.

In 1896 the United States purchased a few Whitehead torpedoes from the Whitehead Company in England. These torpedoes were a considerable improvement over the original design and embodied the following features: the warhead contained 200 pounds of guncotton and, through a considerably larger and more improved compressed-air flask, more energy was stored in the torpedo for use in propulsion, resulting in a range of one mile at a speed of twenty-five knots.

The Brotherhood type compressed-air engine was used having three radial cylinders 120 degrees apart in the same plane. This engine was capable of 38 horsepower with a working pressure of 400 pounds per square inch.

By a system of bevel gearing the power delivered to the shaft was divided between two coaxial propeller shafts turning in opposite directions, the propellers being in tandem. This change was made to keep the torpedo on even keel during the run by balancing the side thrusts of the propellers.

Part of the intrinsic energy of the compressed air in the main flask was given up to the engine pistons after reduction in pressure to a predetermined amount by means of a reducing and constant-pressure regulating valve. Some of it was likewise utilized in the process of expansion to the working pressure.

Having started at atmospheric temperature, very low temperatures must have been encountered in the engine cylinders with rates of expansion used, especially during the latter part of the run. These torpedoes were equipped with a spring-loaded hydrostatic diaphragm which was connected to the air motor valve for operating the depth rudders.

THIS diaphragm, through its control of the depth engine, balanced seawater pressure on one side against atmospheric pressure in an adjacent chamber on the other, plus the spring load, which was adjustable.

By regulating the initial tension of the spring the torpedo could be set to run at any desired distance below the surface of the water and thereby make an underwater attack upon a vulnerable part of the enemy's hull.

These torpedoes were maintained in direction by vertical vanes at the after end, the correct setting being a matter of trial and error. The introduction of a gyroscope for the purpose of deflection control had not been made at this time.

In addition to those major units, there were several minor ones such as valves and small mechanisms necessary for charging, starting, and proper control during the uncertain period of the beginning of the run. Thus it was necessary that the entire mechanism of the torpedo be put into operation by the tripping of one valve; that the proper amount of horizontal rudder be maintained during the period required to get up speed to the point where the rudders could exert sufficient force to control the torpedo in depth and then restore the function to them; that the torpedo be capable of being fired in times of peace for practice running in the instruction of operating personnel and for calibration purposes and its recovery insured under these conditions, yet in time of war be capable of self-destruction to prevent falling into the hands of the enemy.

Shortly after the acquisition of these torpedoes from England, the torpedo was greatly enhanced in value as a weapon of precision by the invention and introduction of a gyroscope con-

A torpedo is fired from the launching tubes of a U. S. destroyer (Navy photo).

trol of the vertical rudders which in turn controlled the course of the torpedo. The original application of a gyroscope to a torpedo was made by an Austrian named Obry and for many years torpedo gyroscopes were known as Obry gears.

Obry's design, which was considered satisfactory for a time, was a toy affair that was spun by a spring. In today's steam torpedo the gyro receives an initial spin from a small high-pressure air turbine which performs the function and disengages itself from the gyro in less than a half second.

THE speed derived from the initial impulse is maintained and increased to 18,000 r.p.m. by a continuous impulse from an air stream directed to sawtooth buckets cut in the rotor periphery, which sustains it during the run of the torpedo. It operates for such a length of time that corrections for latitude have to be applied to it for counteracting the effects of the earth's rotation.

Shortly after this improvement, the E. W. Bliss Company of Brooklyn, N. Y., purchased the right to manufacture Whitehead torpedoes in the United States and, through the application of some exceptionally skilled engineers, began a long period of improvement in torpedo design which, with the coöperation of the Government's torpedo facilities, finally resulted in the building of a new type of torpedo possessing many improvements over the basic Whitehead design in matters of mechanical detail and broader applications of sound engineering principles.

THIS new design divorced the United States from the dependency upon the common torpedo of other nations and by its better engineering applications has, we believe, enabled us, through still later improvements by naval engineers, to produce torpedoes which in general performance are superior to any in the world.

In 1901 the first installation was made of an air preheater in the air flask. This preheater was of relatively small capacity and was mainly for the purpose of obtaining a greater weight of usable air at the end of the run by increasing the temperature—hence pressure—of the frigid air by burning an alcohol jet in the air flask. It also served the useful purpose of using warmer air in the engine cylinders with resulting betterment of lubrication, hence reduction of friction losses and casualties resulting therefrom.

By this time the air flask was capable of withstanding a pressure of 1,500 pounds per square inch which, with its cubical capacity, meant a supply of 100 pounds of air by weight. The range of the torpedo depended entirely upon the amount of this air which was usable, or that amount which was expendable until the flask pressure had dropped to a point where it could no longer supply air to the engines at full working pressure.

From then on the run fell off rapidly in speed and range, and this so-called "tailoff" could not be considered as part of the effective range of the torpedo. The pressure at which "tailoff" began was fixed by the reducing valve or regulator setting. The weight of air remaining at this time depended entirely upon its temperature which, in turn, depended upon the rate of expansion or air consumption by the engines.

Thus, the higher the power of the torpedo the greater the percentage of unusuable air. The preheater in the flask was the means taken to overcome this waste of the torpedo's vital energy.

This air flask superheater did not last long, especially after an air flask exploded due to the generation of too high temperature and pressure. The possibility of premature ignition of the combustible fluid introduced for preheating soon caused the rejection of this type preheater as being dangerous, and this resulted in the introduction of the so-called "external preheater," or one in which the air was preheated after leaving the air flask and before it reached the engines.

This step, from an engineering point of view, was an important one. While it was a step backward in the matter of decreasing the supply of frigid and unusable air in the flask toward the end of the run, it emphasized the possibilities involved in the way of increasing the intrinsic energy of every pound of air from the very start, thereby permitting more energy to be given up to the engines per pound of gas in producing useful work.

IT is to be noted that the working fluid, through the use of these preheaters, now known as combustion pots, became a mixture of atmospheric gases plus some products of combustion. Today's combustion pot is fueled by alcohol ignited by a black powder percussion igniter. To offset the terrific temperatures of the burning alcohol supported by the high-pressure air, water is sprayed into the flame which produces steam in addition to nitrogen and varied carbon compounds.

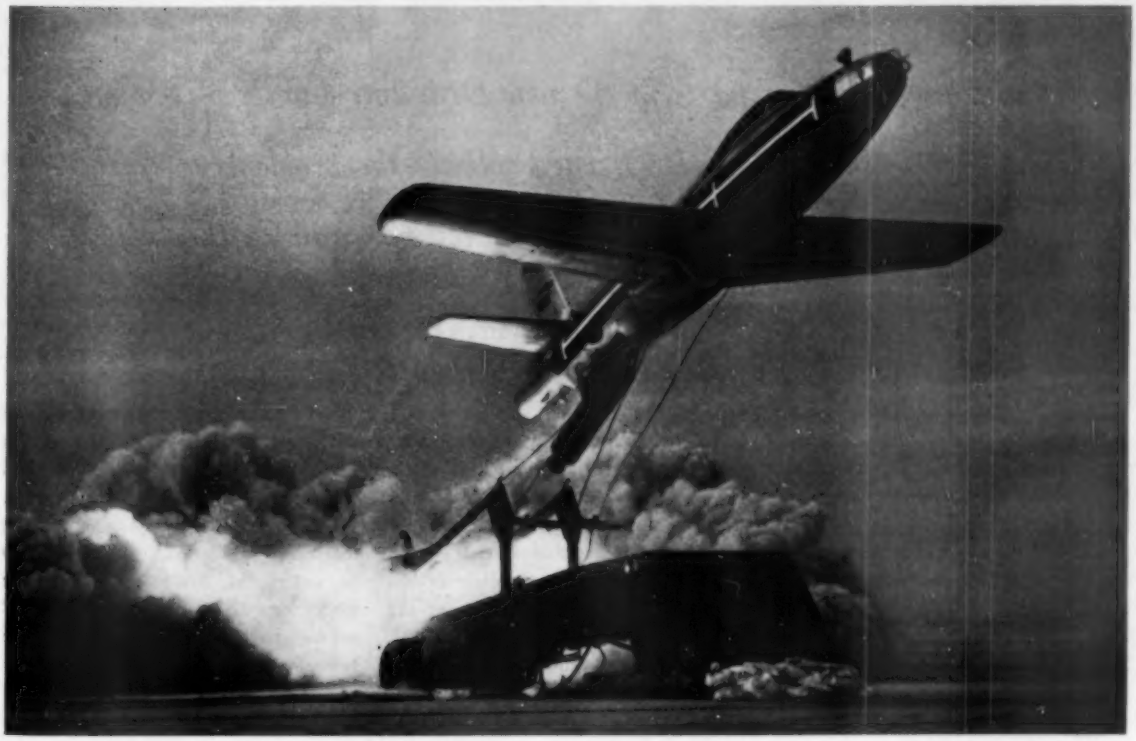
The next important step in torpedo power plant development came when the Bliss-Leavitt combination produced a torpedo in which a turbine was used in place of the reciprocating engine. The advantages of the turbine over the reciprocating engine were so impressive at the time that the change was readily made by the Bureau of Ordnance.

THUS, the power plant used in U. S. Navy "steam" torpedoes became a gas-turbine power plant in which the chemical energy in the combustion pot is delivered up as heat to the working fluid—the gaseous products of a chemical change. At temperatures of 1,000 to 1,500 degrees Fahrenheit, which place these gases in the class of the so-called "perfect gases" as far as their thermodynamic behavior is concerned, the intrinsic energy is converted to kinetic in the turbine nozzles, expanding to engine back pressure.

Improvements in steam torpedoes over the old Whitehead design have occurred regularly through the years, all tending to increase reliability, facilitate adjustment, and lessen manufacturing difficulties.

For purposes of comparison, the principal specifications of the latest steam (air-alcohol-water) submarine-fired U. S. Navy torpedo are: diameter, 21 inches; over-all length, 20 feet; combat weight, 3,000 pounds; speed, 45 knots; range, about 8,000 yards.

New Aircraft Launchers



Two recent innovations in launching aircraft are shown here. Above, with the aid of a booster bottle an Air Force jet fighter takes off from the zero-length launcher developed by Martin Aircraft. Below, a Navy Chance Vought F7U-3 Cutlass is being launched from a steam catapult developed by the British to handle heavier aircraft from carriers (Navy photo).

All for One, One for All

Interchangeability of parts in the new Ordnance family of combat vehicles is going a long way toward solving the problems of costly maintenance and overburdened supply lines, now and for the future

William M. Trevarrow

BETWEEN World War I and World War II only eighteen tanks were built for the United States Army due to lack of appropriations for this purpose. During the same period little or no research and development work was authorized in the tank-automotive field. Therefore, when it became apparent that the United States was about to become involved in World War II, the Army was virtually unprepared to produce combat vehicles. There were no available drawings nor were there facilities for tank construction.

To provide equipment for a rapidly mobilized Army at the beginning of the war, the Ordnance Corps ordered crash production of many combat vehicles, some of which were not then completely engineered. Everything was done quickly. Vehicle designs were completed based on concepts that were current in the early 'thirties.

The Detroit Arsenal manufacturing facility was built, and tanks were rolling off the assembly line less than a year after a contract was signed with the Chrysler Corporation. Other manufacturers stopped civilian production and converted their facilities to military use. In order to speed up production, engineering was often done simultaneously with the manufacture of a vehicle.

NORMALLY, from four to five years are necessary to engineer, test, and manufacture a combat vehicle. During the war, however, this cycle was reduced to less than one year. To accomplish this, engineering and uniformity had to be sacrificed. Two or more manufacturers producing the same vehicle might supply an end item similar in nomenclature, external appearance—and little else. Additional changes on the basic design occurred as late modifications were made in the field or the depots just prior to shipment.

Because every vehicle was comprised of dissimilar components, depot stocks were tremendous. Add to this certain incongruities that developed, such as the fact that five different engines were used to power the M4 medium tank, and an idea can be gained of the supply and maintenance problem that grew, like Topsy, during the course of the war.

This was not the fault of the manufacturers or of Army Ordnance. Rather it was the natural result of a crash production program at a time when America was totally unprepared for war.

Despite the seeming confusion in the tank-automotive field during the war, vast strides were made in the development of new vehicles. From the bulky, hard-to-maneuver tanks, such as the M3 and M4, armed with relatively small guns, came the later M24 and M26 tanks which were to be the direct ancestors of the postwar fleet of vehicles.

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As a result of the experience gained during the war, the Ordnance Corps is developing a fleet of combat vehicles which will use common components. This is, of course, a long-range program that must be continually modified. To be successful, existing field-service stocks must be refined, eliminating unneeded parts, and catalogs must be brought up to date.

The first benefits of this program can now be seen in the tank family which has been under development at the Detroit Arsenal since the end of World War II. The family concept, as explained by Col. George T. Petersen, chief of Research and Development at Detroit, is directed toward attaining the highest possible degree of interchangeability. This applies not only to vehicles in the same class but also between classes.

Interchangeability is accomplished by developing and using parts that are common to many vehicles. The engineers design assemblies to allow the maximum use of standard items. They also review and study existing assemblies to assure that standard items will be used to replace those that are not standard.

Finally, a great deal of redesigning of nonstandard into standard components is done. Thus, the use of interchangeable items in the system is increased, and parts procurement and supply are simplified. One of the best examples of the advances made is in the field of electrical components.

An important derivative benefit to be

realized from this program will be the ease with which the entire fleet can be maintained. A much smaller maintenance force will be necessary, and it can be trained in a much shorter period of time. Because so many components are common to all vehicles, special instructions will be needed only on those features peculiar to a particular piece of equipment, such as the 155-mm. self-propelled howitzer, M44.

The tank family is made up of three groups: the light tank group, the medium tank group, and the heavy tank group. In the light tank group are the following vehicles:

M41 light tank; M42 twin self-propelled 40-mm. gun; M8A1 cargo tractor; M44 self-propelled 155-mm. howitzer; M75 armored infantry vehicle; T43E2 cargo tractor; T98E1 self-propelled 105-mm. howitzer.

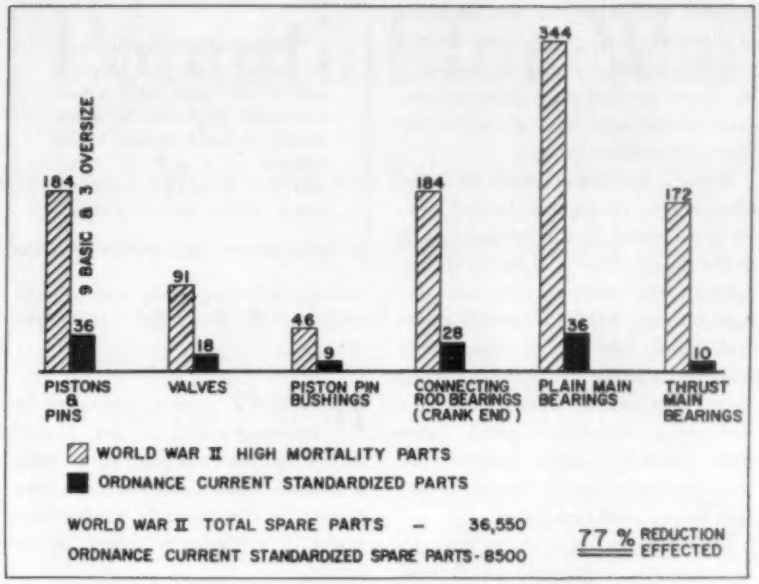
Five vehicles comprise the medium tank group:

M46 medium tank; M47 medium tank; M48 medium tank; T97 self-propelled 155-mm. gun; T108 self-propelled 8-inch howitzer.

THE heavy tank group presently contains the T43 heavy tank and the M51 recovery vehicle. In all, there are fourteen vehicles now being manufactured or in the hands of troops. Others are, of course, in the process of development or are being tested. They form the basis for a fully mobile, armored fighting force.

Before the family concept could be made a reality it was necessary to have available major components that could be used in a wide variety of vehicles. In 1943, work was begun on a series of engines and transmissions which could be adapted to a wide variety of vehicles. From this program developed the Ordnance-Continental engines and the Ordnance-Allison cross-drive transmissions. These fundamental components are the heart of the family program. Two basic engines provide power for the entire 1955 tank fleet.

Compare these figures with the earlier situation when five engines were used in one vehicle. That was an extreme case, but one that graphically



Comparison of types of parts required for tank-automotive vehicles in World War II and those needed with current Ordnance engine standardization.

demonstrates the pitfalls of a hasty development program. The two transmissions, developed concurrently, complete the power package for the tank family.

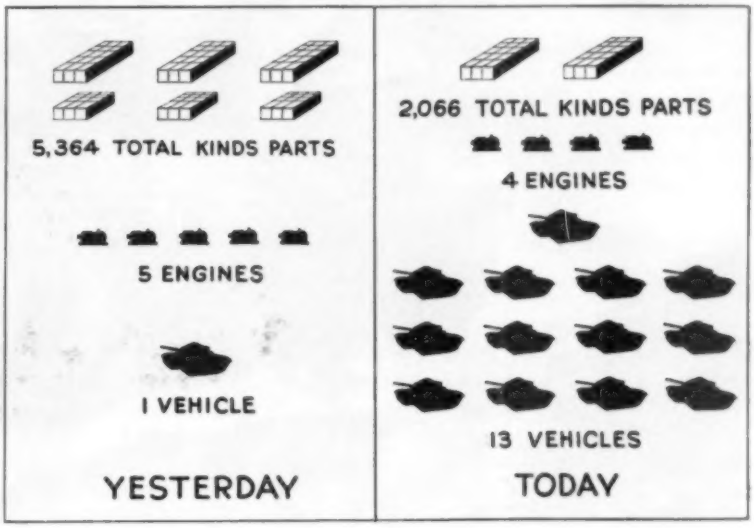
The maximum interchangeability of major and minor components is naturally attained on vehicles within each group. In the light tank group, all seven vehicles use the 895 engine and the CD500 transmission. The final drive and the track components are also the same for the vehicles in this group.

In the electrical system the same 150-ampere generator is used for all members of the group as is the same booster coil. Ten years ago, on the other hand, seven vehicles in the field may have required as many as fifteen different generators if a full maintenance stock were kept in the depots.

In the case of the medium tank group, the 1790 engine is used and the CD850 transmission. Other components are common throughout this group just as they are in the light tank group.

As the T43 heavy tank and the T51

With today's interchangeability, only 4 types of engines are needed for 13 different vehicles and far fewer parts are required than formerly.



recovery vehicle are the sole members of the heavy tank group, there is little problem of intragroup interchangeability. A vast number of components, however, are the same as those used in the light and medium groups.

Perhaps the best example of interchangeability throughout the tank family is evidenced by the advances made in the standardization of electrical components. The following items are common not only to every member of the tank family but also to many Army wheeled vehicles: tail lamps, driving lamp, light switch, ammeter, oil pressure gauge, temperature gauge, waterproof connectors, cable, batteries, battery terminals, circuit breakers, ignition fittings, and fuel gauge.

In addition to these, many items are common only to the vehicles in the tank family, including the 150-ampere generator, head lamp, bilge pump, magneto, spark plugs, starter relay, starter, booster coil, and radio terminal box.

The various engines also demonstrate a high degree of interchangeability. One hundred per cent interchangeability of high-mortality parts has been attained in the engine-development program. Such items as pistons, cylinders, valves, connecting rods, and cylinder heads can all be changed from engine to engine.

"An important derivative to be realized from this program will be the ease with which the entire fleet can be maintained. A much smaller maintenance force will be necessary, and it can be trained in a much shorter period of time."

HOWEVER, engine component interchangeability is not limited only to the high-mortality parts. Many thousands of other items are also interchangeable. Consequently, much smaller stocks of replacement spares are required.

The extent of this program is shown in the diagram on page 727 in which a comparison is made of the number of items stocked during World War II and the number stocked today to maintain all Ordnance vehicles. It will be noted that the replacement requirements for valves alone have been reduced approximately eighty per cent.

The foregoing gives an indication of the extensiveness of the family program and of the savings in manpower, shipping, and dollars that are being effected. For the first time Ordnance is producing vehicles that are designed to be maintained easily, economically supplied with spare parts, and capable of manufacture by many different producers.

The family concept originated at the Detroit Arsenal and was made possible by the joint efforts of Ordnance and industry. It incorporates many ideas that have long been current in the automotive field, not the least of which is that many more manufacturers are able to participate in the Ordnance procurement program. Consequently, realistic price competition in the major-item and spare-parts fields has been greatly encouraged.

THE family program is not static. Rather, it encourages the development of new components and vehicles. Interchangeability grows organically as new vehicles are developed. A result of a 10-year program, the family concept emphasizes the importance of continuing research and development to the Army, industry, and the taxpayer.

The M46 Patton medium tank was the first in the new family of medium combat vehicles.

Economic Potential for War

An appraisal of the theory which strikes a balance between national security and economic interest applied to current international relations, "cold wars," and atomic threats

Rear Adm. John D. Hayes

DURING the last thirty years, the military profession in the United States, almost without realizing it, has been developing a new social science—that of equating the demands of national security with the ability of an economy to meet such demands. In essence this new social science consists of resolving the two basic but conflicting requirements of our modern society—military protection and economic well-being.

A pattern for accomplishing such resolution has been worked out within the social framework of the United States. Four wars have taught Americans how to apply economics to warfare, and vice versa. In each of the wars the domestic economy was used to assure victory while at the same time the economy received a lasting advantage to itself. The Civil War created a unifying action that resulted in our becoming an industrial nation.

WORLD War I initiated the automobile as a major factor in our national life. World War II increased the buying power of the lower-income segments of our population and spread the economy geographically. The Korean affair showed that the United States can make a large military effort without affecting its standard of living. For an America that remains vigilant and conscious of its responsibilities, both security and a way of life are possible.

No such solution has been accomplished in what has become known as the Free World. The real challenges

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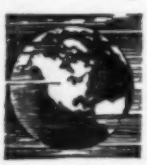
of this new social science are therefore in the international field, in the relations between nations. The world has been made smaller by the airplane and telecommunications, but it is still a world of national entities where political and military interests often clash with economic interests.

This opposition is a manifestation of the contradiction existing between the two great forces in modern society—Nationalism and the Industrial Revolution.

This new social science of equating or striking a balance between national security and economic interest is still without a proper name—possibly because of the reluctance of economists or economic historians to recognize the connection between economics and warfare. An important division of this science, however, has had recognized standing since 1919.



The French at the Versailles Conference, in trying to put a military value on Germany's inherent economic superiority, created the term "war potential" (*potential de guerre*) and from it came the expression, "economic potential for war."

The study of this potential endeavors to isolate those factors in the economic and social life of a nation which can contribute to its military power and attempts a nonarithmetical summation of the value of such factors. In the present bipolar world, this concept of economic potential for war is extended to include groups of nations that may be allied.

The subject of economic potential for war is both a synthesis and an abstraction. Definitions for abstractions usually are unsatisfactory, and it is certainly the case here. This subject is too complex, too hard to handle, to stuff inside a definition. It can be explained better by a graphic representation or analogy.

SEVERAL types of graphic analogy have been used for this interpretation, such as pyramids and axes, but a circular representation is preferred here for reasons that will become apparent.

One very good reason is that God created the circle but man invented the straight line. Analogy is a weak form of logic and can never completely indicate reality. All that is hoped for here is that it will assist the reader to form his own mental concepts.

Figure 1 is a circular representation of national strength, war potential, and economic potential for war. This representation can best be explained by beginning at the center and proceeding out to the circumference.

At the center is the core of a nation's strength—the people with their philosophy and their moral and psychological attitudes. Next to this core is the

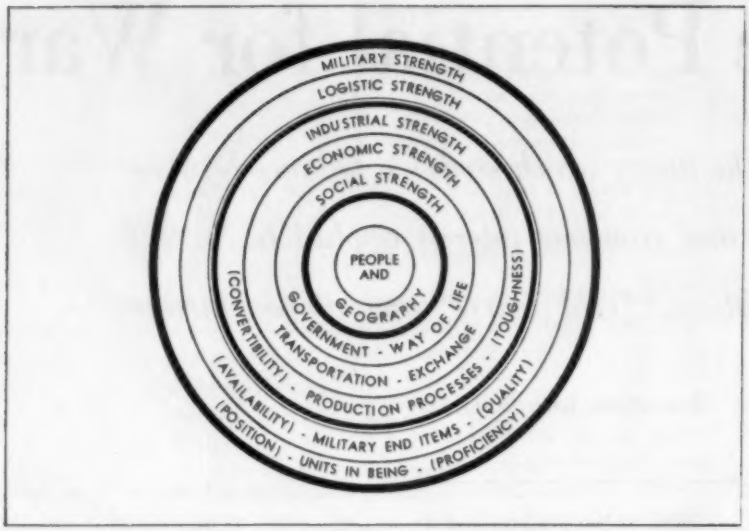


Fig. 1. Concentric component theory of national strength and war potential.

ring representing geographical strength which includes location, size, features, and resources. People and geography are the basic elements of national strength which remain fairly stable in our modern changing world.

From people and their geography comes social strength, the next circular ring. Social strength manifests itself in a form of government and a way of life.

THE next ring is economic strength. Every community, no matter how primitive or backward, must have an economy to function. The two basic requisites are transportation and a financial system or some form of exchange. Transportation is the physical movement of goods, services, and ideas, and a financial system is a means for exchanging them in terms of value.

The basis of a financial system is money, but its real essence is value. In the United States we are able easily to equate value and money. That is why our economy functions so well. Such is not the case the world over, especially in some of the ancient cultures with which we now have to deal. This difference in approach to value has caused many headaches in our foreign aid programs.

The next three rings are easily explained. Based on economic strength is industrial strength which is primarily the capital industrial structure or the industrial plants with their production methods and their efficiency. To a military man, the most important factor in the industrial strength of a nation is its convertibility to war effort, and in this day of atomic threat, its toughness. Based on industrial strength is logistic strength which includes military end items, their quality and availability. Finally there is military strength which is, for our purposes, the location and proficiency of the units in being.

Figure 1, therefore, is a representation of national strength or national power. *War potential* is the ability to transmit that power from the outer ring in the form of military effort. *Economic potential for war* is considered as being that part of the disk within the double circles; *i.e.*, all but the two outside rings which depend on it.

The important feature of a modern economy that this circular analogy illustrates is that the potential of each of the rings is dependent on the strength of the rings within it. Every element in the national economy is dependent for its effectiveness on an even more basic element.

IT is now necessary to transfer mentally from the ring analogy of Figure 1 to the "pie" analogy of Figure 3. In this representation the over-all peacetime output of a modern economy is shown in segments.

One segment includes all the fixed charges against the economy. For the United States these form about one quarter of the pie. These fixed charges include those for government, those for the permanent military establishment, and those for the education of our youth and for the care of our old.

THE biggest part of the pie is the requirement of the economy itself—that needed to keep the economy going. This part is essentially the summation of all the goods and services that citizens produce to fulfill the needs and desires of one another.

The final segment is excess capacity in the forms of savings, know-how, and entrepreneurship. Excess capacity is the dynamic element in the economy. When it is large, it has the tendency to expand outward as shown in the diagram and so cause the whole economy to grow. On the other hand, if excess capacity is too small it shrinks inward and the whole economy will shrink accordingly. A modern economy will not remain in its *status quo*.

In war this excess capacity is used for part of the military effort. Referring again to Figure 3, military expansion in war is so great that it must proceed in two directions—in the radial direction as excess capacity and also in the angular direction as military output replaces civilian.

The military expansion in the radial direction will cause the civilian capacity to grow with it. If the capability of the economy is large, the growth of the civilian portion in the radial direction may more than make up for its cut in the angular direction.

This concept of economic potential for war was certainly valid in World War II, but what validity does it have in the face of today's realities such as the "cold war" with its attendant limited conflicts and the threat of nuclear weapons?

The case of cold war may be examined first. It is generally accepted today that relations between nations can no longer be put into the easy categories of peace and war. There are different conditions of peace and there are different modes of warfare. What is more

significant is that there is a sort of continuity existing among all these.

A nation cannot have peaceful security unless it is willing to prepare for war. Cold war is ineffective unless there is a willingness to use armed might to back it up. A war cannot be kept limited if a nation does not have the capacity to fight a general war, as the Japanese learned in World War II. And, in this industrial age, winning a general war is dependent upon economic potential.

Returning to Figure 1, what we are doing in the present cold war is devoting a segment of our national strength to maintaining our position of leadership in the free section of the divided world. Today a part of our social, economic, industrial, and logistic strengths have to be allocated for psychological and economic warfare.

WHEN cold war extends into limited war we also use a part of our military strength. The trouble with limited warfare is in keeping it limited. In such warfare we use only a selected portion of the military ring of Figure 1, but, if the enemy chooses, he can also hit back anywhere else around that circle. Unless carefully controlled, a military effort can spread until it includes its whole ring. Then there is general war, for the whole disk is in it.

What about the atomic threat? There are two facts that transcend all others in today's world. The first might be called the ubiquity of the airplane; that is, its ability to get anywhere, to be everywhere, and to disregard geography. The second is the destructive power of nuclear weapons.

Heretofore enemy military efforts against a nation's strength have been against the outside or military ring in Figure 1. There were some means of getting at the inside of the disk such as blockade, but these were secondary to the destruction of the hostile military forces.

Now the airplane, with its ability to disregard geography, can get at any of the inner rings.

So it is important that military people not only have a general idea of economic potential but also that they know the size, strength, and toughness of each one of the concentric components of national strength that form it. The same thing must be known about our prospective enemies, and we have to know it now. The concept of economic potential for war has more validity today than it ever had.

Up to now we have been showing economic potential for war on a national basis only. The nice analogy of the concentric rings will not hold for an international basis. The world as a whole is a long way from being an integrated social and economic unit like the United States. Rather it is a collection of national entities joined international relations.

THE physicist's idea of the inside of the atom offers a better means for explaining the international concept of economic potential. The world can be thought of as something like an oversized atom with nations acting like electrons subject to various forces called international relations. The two dominant forces are the politico-military and the economic.

The difference in character and effect of these two forces is what causes the circular analogy previously shown to be useless in this case. However in an atomic analogy these two divergent forces can be represented as force fields acting on the national electrons.

Figure 2 shows an alignment of national entities according to the politico-military force field. The political world today is said to be bipolar, meaning that the politico-military field is energized by two opposing poles. It is similar, therefore, to the electromagnetic field of physics. One of these poles is democratic with aims of security and evolutionary development. The other is communistic with aims of revolution and expansion.

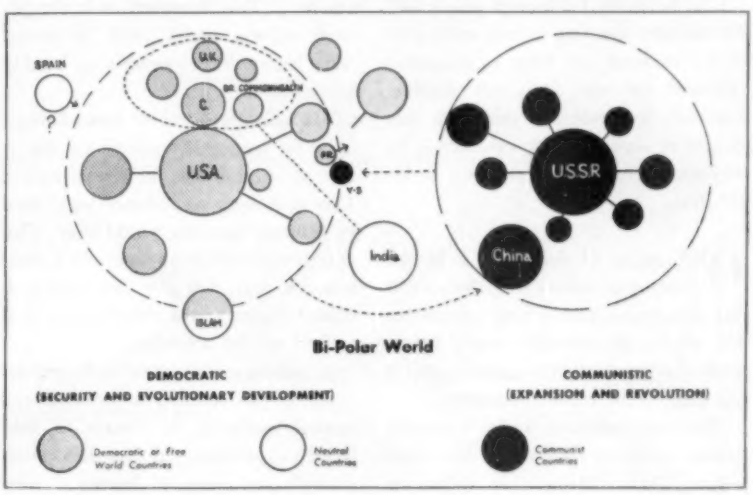
Nations adjust themselves in this force field according to their circumstances. Some are on the Free World side, some are within the Soviet orbit. The pull is strong on some, weak on others. A few, like India, Switzerland, and Sweden, are in the neutral area outside the influence of either pole. Some, like France, would like to get into the neutral area.

Yugoslavia and China have shifted from the influence of one pole to that of another. Some nations are subject to minor influences within the major force field as, for example the British Commonwealth of Nations.

THE economic force field is of an entirely different nature. Instead of being created by the two opposing political poles, it is generated within individual economies and is exerted directly by one or the other. It acts like a gravitational field in physics and hence cannot be satisfactorily represented on a chart.

The character of any economy de-

Fig. 2. Electromagnetic double-field analogy of present international relations.



pends on three basic essentials: food, other natural resources, and industry. A national economy usually contains all three of these elements, but they are seldom—if ever—present in the proper balance.

THE economic dependence which nations have on one another varies according to the size and distribution of these essential elements within their own boundaries. When elements are badly out of balance or actually missing, nations have to depend on one another, and in some cases such economic dependency works itself into a formal system such as the Sterling Bloc. In other cases, economic forces are strong enough to overcome political forces as in the case of Ceylon trading rubber to the Soviet Union.

This concept of nations being subject to two types of forces can be called the double-field theory of international relations. In the twentieth century the politico-military field dominates, and that is why the national units have been distributed according to this force field in Figure 2.

If this analogy were made in the nineteenth century, the distribution would have been according to the economic force field, for at that time international relations were influenced mainly by the free-trade policy of Great Britain.

There are other forces in the world such as religious and cultural forces, but these are relatively weak in modern times.

It is necessary for foreign policy and for military planning to have some idea of the measure and value of economic potential for war. It is not possible, however, to determine this with any degree of accuracy or to calculate it by any sort of formula. It can only be estimated.

ONE means of doing this is by the method of indices whereby a small but measurable part is used to indicate the whole. An example would be annual steel production as an indicator of the state of the national economy.

The first systematic study of national power potential was made by Adm. Alfred Thayer Mahan. His index was sea power which, in essence, is maritime geographic position. The British geographer, Sir Halford J. Mackinder, claimed that manpower should also be included as an index. Brooks Adams, the Harvard historian of the Adams family, ransacked history to prove that mineral wealth and national power went together.

After World War I, the French advanced the concept of economic potential for war, and since then economic indicators generally have come into use. Among these are steel production,

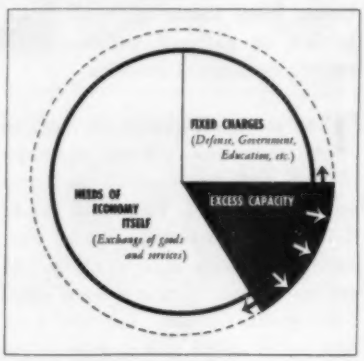


Fig. 3. Output distribution of a modern dynamic economy showing how excess capacity growth causes entire economy to expand.

transportation, and gross national product.

A new index which may have possibilities is that of interindustry relationships. This is also called the input-output method and is nothing but the analysis of the services we perform for one another, the analysis of that major portion of the economic pie shown in Figure 3. This, however, is a complicated process, and it will be several years before it is available in readily usable form.

The second method for determining a value for economic potential for war is that of an estimate of the situation. This is a form of military logic used by military men the world over. This discipline considers all aspects of a problem for fear that the one which is missed might be the decisive one. It is a check-off list procedure.

A technique has been developed for applying this method to strategic and tactical problems. It consists of four steps: (1) mission, (2) own and enemy strength and weakness factors, (3) enemy capabilities and own courses of action, (4) decision.

The estimate of the situation was first developed by the German General Staff under the elder Moltke and was applied primarily to tactical situations. It was introduced into the Naval War College by Capt. Henry C. Taylor and Lieut. McCarthy Little about 1896 and into the Army War College on its founding in 1903. It was also introduced into the curriculum of the Command and General Staff School, Fort Leavenworth, Kans.

Prior to World War II it was extended to strategic problems. Since that war, however, the whole technique of the estimate of the situation has fallen into disuse among the military profession. The staff study has taken its place.

The estimate of the situation process now seems to be having a rebirth on the national level, especially in the economic approach to military power and national strength. It has not been so identified, but the basic four steps are evident in the national and military planning efforts since 1947. The first two steps have almost been completed, and our national and military councils and planning groups are moving into the third.

The first step, the mission, was set out for us after 1946 by the Soviet insistence on continuous and recognized antagonism between the Communist and non-Communist worlds. For the first time in our history, military people had their mission outlined for them in peacetime.

IN studying economic potential for war we are performing step two. We know now with considerable certainty our own economic strength and weakness factors. After much effort and many false starts we are beginning to find out something of the similar potential of the Soviets.

We are only now starting to move into the third step, determining enemy capabilities and our courses of action. Perhaps progress from now on will be faster and we shall not be too long in reaching the final step—a decision which will insure the future security of our country and our way of life.

Announcement

The Thirty-Seventh Annual Meeting
American Ordnance Association

San Francisco, California

¶ **Preliminary plans** for the Thirty-seventh Annual Meeting of the Association —this year to be held under the auspices of the United States Navy—are being made for San Francisco, Calif., on Tuesday, May 10, and Wednesday, May 11, 1955. These dates await final confirmation by the Navy Department.

¶ Arrangements are being made with the Hotel Fairmont, San Francisco, for the Annual Dinner Meeting and Technical Sessions.

¶ **Plans for First Day** include technical sessions on "Tomorrow's Armament" at which papers will be presented by representatives of the armed forces; a discussion on Defense Mobilization; a Seminar by American industry on Trends in Industrial Defense; and the Annual Dinner at which a senior Naval dignitary will be the guest of honor and principal speaker.

¶ **On the Second Day,** members will assemble, probably at the Naval Air Station, Alameda, to witness demonstrations afloat of Naval armament and aircraft in action.

¶ Invitations, and full details for both days will be sent to all members when planning with the U. S. Navy is crystallized.

Dynamic Preparedness

An account of how one American company, through its own industrial mobilization plan, is readying itself to produce equipment for our armed forces and to continue production in the face of enemy bombardment

Brig. Gen. O. J. Gatchell

Control Officer, Defense Products Group, American Machine & Foundry Company, New York, N. Y.

This is the second in a series of case histories of industrial preparedness being published in this magazine to recount how American industry has aided the national defense in the past and how it may be relied upon to equip our armed forces in any future war emergency. The first article in the series appeared in the January-February 1955 issue of ORDNANCE.

DURING the past fifty-five years American Machine & Foundry Company has grown from one small plant specializing in the design and manufacture of tobacco-industry equipment into a nationwide twenty-five-plant operation, manufacturing more than fifty major types of products. Aside from its production of equipment for the home, retail trade, and for industry, A.M.F. is heavily engaged in the defense program as a major prime and subcontractor, manufacturing airborne torpedoes, radar antennae, gun mounts, electronic and ultrasonic trainers, automatic gun loaders, cooling fans for Army tanks, mobile baking ovens, helicopter rotor hubs, and other aircraft subassemblies.

In the nuclear-energy field, A.M.F. was a major subcontractor on the Savannah River project, responsible for design and manufacture of control mechanisms.

During World War II, this company devoted about ninety-five per cent of its facilities to the production of war materials, making only enough repair parts for its proprietary products to keep its customers' machines in operation. Like other companies, it had been designated for mass production of a particular class of munitions, but management felt that its resources—in special equipment, in engineering "know-how," and in specially trained personnel—would make a more significant contribution to the total war effort if they were not confined to work on a single prime contract. Accordingly, management persuaded Ordnance officials that the most productive rôle for A.M.F. was as a subcontractor for other firms holding prime contracts with the Army and Navy.

The company made perhaps its greatest contribution to the war effort by designing and manufacturing the mechanical elements of radar. Most carriers and battleships of the U. S. and British navies had A.M.F.-built antennae at the top of their masts. A.M.F. also built antennae for use in B-29 bombers, and a small pedestal-type radar, nicknamed "Li'l Abner," used in land operations in the Pacific.

During 1948 the United States witnessed a definite trend toward mobilization of industry to support a major increase in the strength of the armed forces of the United States and to provide logistical aid to the services as well as to the national economies of other nations opposed to the expansion of the Soviet Union. It was necessary then to review company policy and to gear it to the defense program, and it was also necessary to take into account the diverse, additional manufacturing facilities that A.M.F. had acquired since the war.

A COMMERCIAL research and development department had been formed in 1944 to seek out new products in which the company could profitably invest its capital and engineering skill in the postwar period.

As a result, A.M.F. acquired twelve companies in various fields, all selected on a basis of strong identification with a peacetime product and with a reasonable convertibility to defense work. Many of these new facilities were capable of mass production of special items. Accordingly, A.M.F.'s chairman and president, Morehead Patterson, adopted a policy of greater defense production and full participation in industrial mobilization planning, with emphasis on prime contracts in addition to subcontracts as in World War II.

This was followed by a series of mobilization bulletins instituting plans for conversion of the company's facilities to defense production in the event of a national emergency. In order to be prepared to swing efficiently into high-speed manufacture of critical devices, when the full effect of an emergency arrived, Mr. Patterson arranged for all plants to participate in the defense program.

Six months after the beginning of the Korean war, the backlog of unfilled prime contract and subcontract orders had increased fivefold. During World War II only four per cent of A.M.F. productive effort was directed toward completion of prime contract work, whereas during 1952 about fifty per cent was so directed.

However, many of the large prime contractors who were so dependent upon the company's facilities during World War II were again planning to send it vital subcontract work. Thus, it became necessary to plan balanced production, including both prime and subcontracts, in order to make the most efficient use of our maximum wartime capacity.

THE utmost care had to be taken to assure that should M-day come, A.M.F. would not find itself in the undesirable position of having overscheduled prime contract work to the detriment of vital subcontract work; or, conversely, of overcommitting on subcontract work to the point of being unable to execute prime contracts.

The broad objectives of industrial mobilization planning at A.M.F. are twofold: first, to facilitate the transition from a semipeacetime economy to full-blast mobilization effort; and, secondly, to provide a basis for the present negotiation of contracts and firm commitments for the production of special items. More specific objectives of industrial mobilization planning at A.M.F. are: to determine the company's capabilities for production in peace and war, and to furnish a guide for allocating its capacity for both proprietary and defense production in peacetime, under limited mobilization, and under full mobilization.

We also try to anticipate and prepare for problems of production under mobilization—manpower, priorities, and allocations; to provide a basis for the negotiation now of tentative schedules of production; to provide a basis for current production orders of defense items scheduled for manufacture in greater quantity under mobilization; and to provide a basis for negotiation of contracts for industrial-preparedness measures.

A.M.F. policy attempts to indoctrinate key personnel in the essentials of industrial mobilization planning and wartime operations; to coördinate industrial mobilization planning with current production in order to minimize "lead time" in conversion to defense production and in subsequent reconversion to commercial production; to provide for continuity of operations under enemy attack; and to provide a basis for the continuous review and revision by responsible elements of the company of industrial-mobilization and related plans to insure that they are realistic, up to date, and are consistent with national policies.

The American Machine & Foundry plan encompasses all phases of the company's planning for capacity operation under either full or partial mobilization conditions. The plan is divided for convenience into five separate volumes and deals with the following subjects:

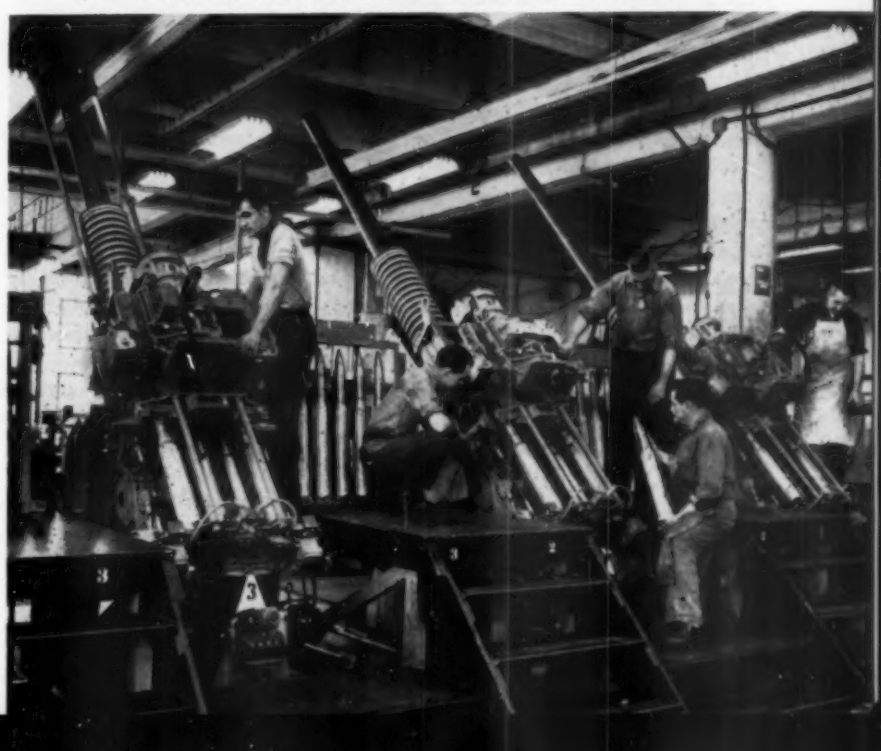
Part I consists of a brief history of the company, an introduction to the plan, a statement of its scope and objectives, and a frame of reference for mobilization production plans and continuity of operations under attack. Part II describes A.M.F.'s facilities, productive equipment, products, and engineering, research, and development services.

Part III contains capability surveys of each facility, with plant layouts, an analysis of present production and potential productive capacity, and an allocation of that capacity to military, military-supporting, and civilian requirements. Part IV is devoted to implementation of the plan. This volume consists of company directives, standard practice instructions, and assignments of administrative responsibility.

PART V covers an employee-identification system, measures for the prevention of sabotage and espionage, fire and other damage-control measures, protective equipment, armed guards, civil-defense training, and for post-attack operations.

A.M.F. planning began, as all mobilization planning must, with a survey of our facilities including an analysis of the capacity of existing facilities, assuming availability of manpower and materials; the percentage of maximum capacity which it is desired to reserve for civilian production; the amount re-

Automatic loaders for the Navy's new rapid-fire, 3-inch, 50-caliber guns are typical of current American Machine & Foundry defense work.



served for unscheduled military and military-supporting production; the percentage scheduled under tentative schedules of production; and that available for scheduling of prime contracts. This is the basis for plans for the negotiation of additional tentative schedules of production.

The purpose of the surveys was to determine the present and potential capability of each facility, the effect of mobilization on the production of items presently manufactured, and the items or types of items which the facility was prepared to produce in the event of mobilization.

THE principal problems to be expected in war production for industry as a whole and for the individual facility are the determination of requirements of products and materials, the availability of machine tools and other productive equipment, the supply of essential materials, and manpower.

In the past, the procedure for the armed services has been to prepare, on the basis of the strategic plans, an estimate of requirements. A liberal factor of safety was used with the result that the aggregate of military requirements far exceeded the gross national product.

With these provisional estimates as guides, the Department of Defense undertakes realistic planning of requirements. Thus the process of supply-demand approximations is carried on. The defense requirements will undergo continual changes in accordance with changes in strategic plans and development of new weapons.

Consequently, tentative schedules of production will be under periodic review.

The greatest bottleneck in machine tools comes, of course, during the initial period of mobilization. A list of machine tools at each A.M.F. facility has been included in the surveys furnished to the Department of Defense. This plan provides that each plant manager determine the additional machine tools needed to accomplish the planned war production and the necessary modernization or replacement of existing tools.

The Controlled Materials Plan, which evolved in World War II from a trial-and-error process in control techniques has been superseded by the Defense Materials System. This system, like its predecessor, concentrates on the control of a few major materials. But the individual facility's problems of procurement of materials in wartime may go far beyond that.

Unexpected shortages, transportation delays, and other factors may plague the best production control systems. For this reason the A.M.F. plan provides for the maintenance for each facility of a list of suppliers and alternate suppliers of all materials and components used by the facility.

It is further proposed, where consistent with reciprocal relations, price, and other considerations, that some business be given to such alternate suppliers in order to establish commercial relations which will facilitate subcontracting and procurement in the event of mobilization.

A wartime recruitment and training plan for new employees includes plans for use of female labor, retired employees, and the physically handicapped in jobs for which they are qualified and in which they are often capable of superior performance. It includes measures to counteract the lure of higher wages elsewhere or attempts at labor piracy.

Additional amenities needed, including rest and recreation rooms and lunchrooms will be planned in advance. To the extent feasible, construction and repair jobs are planned for any period of shutdown during conversion to war production.

A.M.F. has a complete standard practice instruction for cases where deferment of essential employees is desired under selective-service procedures. Data on draft status of all employees at this time is of little value because of constant changes in age and dependence status. Until a wartime draft call is issued it is difficult to assess the impact of the draft on employment, but the measures indicated in the preceding paragraph have been planned in advance.

Implicit in all industrial-mobilization planning is the rôle of engineering, research, and development. The outbreak of hostilities will bring about not only drastic changes in production but also drastic changes in the demands on engineering. The most obvious and immediate of these is the requirement to produce drawings, bills of material, and other necessary engineering information so that matériel manufacture can be started.

There is another very striking change which occurs. If the enemy's security preparation has been effective, new weapons and techniques will appear. This immediately gives rise to the necessity for high-pressure research and development to produce countermeasures.

Thus, in another war it would be highly desirable to preserve and speedily and effectively utilize organized technical talents and facilities. Their value extends far beyond areas of production design into research and development not normally directly associated with production problems. Accordingly, mobilization plans and work programs are being developed for each of A.M.F.'s eight research and development facilities, in addition to the product engineering conducted at each of our manufacturing facilities.

AMERICAN Machine & Foundry recognized that production in any future major war will take place under very different conditions from those prevailing in World Wars I and II and the Korean conflict. American industry has never operated under enemy attack, but it is assumed that it will be subject to immediate attack in a future war.

The Civil Defense Administration has designated certain critical target areas. Like many other large producers, over ninety per cent of A.M.F.'s productive capacity is located in such areas. A.M.F., however, has one advantage in the fact that its numerous facilities are dispersed from Massachusetts to California. This affords interplant mutual assistance in personnel, equipment, and in actual production. A number of A.M.F.'s defense products can be manufactured in whole or in part at more than one of its facilities. So also its

engineering research and development facilities are widely dispersed.

First in order of consideration of measures to be taken to insure continuity of operations is the establishment of an alternate company headquarters and measures for the safekeeping of company records.

In the event of war, which is the contingency on which all mobilization plans are based, it is only reasonable to assume that an aërial attack will be made on New York as well as large-scale sabotage there which will make it an undesirable if not untenable headquarters. Accordingly, provision is made in Part IV of the A.M.F. plan for an alternate headquarters.

Closely related to the problem of an alternate company headquarters is that of duplication and safekeeping of company records. "Corporate amnesia" can be as completely disabling to a company as to an individual—in fact more so. Duplicate copies of many of the essential records are already available. It is merely a matter of assembling, shipping, and housing them in fireproof storage in the city selected as the alternate company headquarters.

With modern techniques of microfilming, photostating, and other means of duplication, the total expense is cheap insurance against partial or complete paralysis of the company.

The fundamental principles of protecting personnel and property under enemy attack and of all disaster-relief measures are self-help, mutual aid, and mobile reserves. The principles of self-help and of mutual aid apply to the individual, to the plant, and to the community. They include training in first aid, participation in air-raid drills, evacuation plans, and all civilian-defense measures. Individual plant disaster plans are being prepared for all A.M.F. plants.

IN high-explosive bombing attacks on England and Germany during World War II, frequently only one or a few plants in a community suffered direct hits. Therefore, mutual assistance and interplant arrangements within the community were effective.

But in the case of an atomic attack the extent of mutual aid within the community may be limited, and dependence must be placed on mutual arrangements with other cities, on mobile reserves, and on interplant arrangements with plants at a safe distance.

Much of the work of rehabilitation, reconstruction, and resumption of operations is closely related to civil-defense and plant-protection measures but should be definitely planned, organized, and oriented to continuity or restoration of production.

It is for this reason that the A.M.F. plan provides for the appointment of a team at executive headquarters of the company to which will be assigned definite areas of responsibility for the planning and carrying out of rehabilitation operations in the event of a major disaster at any A.M.F. plant.

It also provides a cadre of supervisory employees chosen from other A.M.F. plants to be designated as a team to report immediately to a specific plant in the event of a major disaster at such a plant.

Mobilization planning at A.M.F. is dynamic, not static. As such it is a responsibility involving all elements of the company. Plans have been prepared to give direction to and place responsibility for this vital work upon the whole management team.

"Implicit in all industrial mobilization planning is the rôle of engineering, research, and development. The outbreak of hostilities will bring about not only drastic changes in production but also drastic changes in the demands of engineering . . .

"There is another very striking change which occurs. If the enemy's security preparation has been effective, new weapons and techniques will appear. This immediately gives rise to the necessity for high-pressure research and development to produce countermeasures.

"In another war it would be highly desirable to preserve and utilize organized technical talents and facilities. Their value extends far beyond areas of production design into research and development not normally directly associated with production problems."

A SUMMARY of industrial-mobilization planning at A.M.F. includes the following measures: Recurring conferences of members of the management team are arranged to acquaint them with the status of the effort and to plan each advanced phase or revision of the program. Divisions and subsidiary companies are negotiating tentative schedules of production with the armed services for unallocated mobilization capacities of the production units.

Each facility is preparing production plans and plant layouts for contemplated war production and is planning machine-tool requirements as tentative schedules of production are received. A personnel plan is being prepared for each facility as the foregoing schedules are established. This plan will cover recruitment and training of new employees in event of mobilization. A subcontract structure is being built with mobilization objectives in mind. Contractors who can contribute in case of defense conversion are being selected for commercial production.

An alternate company headquarters for use in event of war is being selected. Plans for emergency transfers to that headquarters are being made. Preparations are being made to duplicate essential drawings, data, and records in storage vaults at this alternate headquarters. Relief and rehabilitation measures in event of a major emergency at any plant are being prepared.

An emergency operations system is being devised so that, in case of an emergency at any plant, designated trained key personnel from adjacent plants will be dispatched to get the damaged plant back into operation. A communications system is being established so that personnel will be alerted and trained for their parts in this program.

As outlined in A.M.F.'s Industrial Mobilization Plan, all divisions and companies have been instructed to plan the utilization of the available unscheduled capacity for items adaptable to these facilities.

Through these measures A.M.F. is preparing itself to serve the Nation in war as in peace.

Presidents of Local Posts of the

Harold D. Duppstadt
Aberdeen Post

Warren Whitney
Birmingham Post

E. D. Rhodes
Capital Cities Post

James R. Munro
Central Illinois Post

R. C. Malvin
Empire Post

Col. Paul S. Bechtel
Florida Post

Stanley C. Hope
Hartford-Springfield Post

Harry Darby
Midwest Post

F. D. Hansen
Milwaukee Post

R. L. Maxwell
New York Post

W. C. MacFarlane, Sr.
Northwest Post

P. S. Mumford
Quad Cities-Iowa Post

Col. Henry E. Minton
Rio Grande Post

James D. Maitland
Rocky Mountain Post

Lieut. Col. W. P. Gatley
St. Louis Post

Association

The Local Posts of the American Ordnance Association, located in industrial, scientific, and educational centers throughout the United States, are a vital factor in the Association's task of fostering industrial preparedness.

These Posts by their meetings, seminars, plant visits, and similar activities keep alive an interest in the continuing need for scientific and industrial know-how in the production of the weapons of defense. The presidents of these Posts, most of whom are shown below, are the key men in this nationwide effort for peace.

Thomas Drever
Chicago Post

John D. O'Brien
Cincinnati Post

Albert J. Weatherhead, Jr.
Cleveland Post

Edward A. Haas
Columbia River Post

Robert C. Geffs
Los Angeles Post

James A. Ward
Louisiana Post

James K. Fulks
Michigan Post

Stanley A. Hoff
M.I.T. Post

W. H. Worrilow, Sr.
Philadelphia Post

A. E. Walker
Pittsburgh Post

Joseph A. Denn
Puget Sound Post

L. S. Fletcher
San Francisco Post

W. H. Miner
Texas Post

George M. Riveire
Wasnington Post

Charles B. Weeks
Yankee Post

Month by Month: Highlights of the National Defense

Better Soldiers

A team of psychologists, anthropologists, and sociologists is studying Army training methods and recently saved taxpayers about two million dollars.

Why is there such a shortage of aggressive young officers?

After quizzing 911 Officer Candidate School personnel at four Army installations, the social scientists discovered that:

1. O.C.S. eligibles were not being properly informed about the program.

2. Many officer candidates balked at the fact that they faced longer active and reserve service than enlisted men.

3. Some preferred not to assume the "responsibilities" of an officer.

"In a typical training battalion of 1,000 men," a report stated, "lack of motivation and lack of leadership each account for a little more than one-third of all O.C.S. attrition; the remaining losses are about equally divided among academic, physical, and other deficiencies."

The research team found that recruits studying map use were confused by such words as "azimuth," "orientation," and "intersection."

The report also declared that learning by doing was better than classroom instructions. It was found that taxpayers could be saved $2 million by the use of $27 mock-up tank hulls instead of $10,000 tank hull trainers.

Earth Satellites

The Defense Department recently announced that the combined efforts of the military services were being devoted to studies of "earth satellites."

An earth satellite, if one is ever built, would be a form of space ship that has long fascinated scientists. The satellite would revolve in an elliptical pattern around the earth.

The late Defense Secretary, James Forrestal, referred to an "earth satellite vehicle program" in his 1948 report. The Defense Department stated that studies on that program were still active.

To become a satellite, a vehicle would have to be launched several hundred miles out in space and attain a speed of 18,000 miles an hour.

American Atomic Status

Speaking at a National Press Club luncheon in Washington recently, Lewis L. Strauss, Atomic Energy Commission Chairman, gave a brief evaluation of the current atomic-energy program. On the asset side of the ledger he noted that:

1. The U. S. is well ahead of any competition. Our large stockpile of atomic weapons "is growing rapidly" to meet the diversified needs of the armed forces.

2. Progress is being made in the development of electric power from the atom. The atomic reactor program, in coöperation with private industry, seeks to cut costs to a point where atom power will be competitive with conventional fuels.

3. The Atomic Energy Act of 1954 opened the door to private industry not only for the public benefit but also for profit. More information was shared with allies.

4. Atomic radiation benefits in the arts and sciences, including medicine, biology, argriculture, and other fields are too numerous and varied to catalog.

5. Free information was expanded while, at the same time, better safeguards for secrets were provided.

6. The President's proposal to the United Nations to provide elements for research reactors in friendly countries inspired plans to call a congress of scientists this summer.

7. The United States has gained the free world's good will by an attitude of humility and restraint.

Secretary Slezak Resigns

Under Secretary of the Army John Slezak resigned from Government service and returned to private business early in January.

Secretary of the Army Robert T. Stevens said that Mr. Slezak came to Washington in May 1953 with the understanding that he would remain for only one year but had been prevailed upon to stay for nearly two.

Mr. Stevens said of Mr. Slezak that his contributions "have been outstanding, and his country owes him a great debt of gratitude for his unselfish devotion to national security."

Mr. Slezak's first position when he came to Washington was as an Assistant Secretary of the Army. He became Under Secretary last February.

According to the Army, Mr. Slezak told the President that compelling personal reasons made it necessary for him to return to his interests in private business.

Mr. Slezak, 58-year-old native of Czechoslovakia, was widely respected at the Pentagon and was generally regarded as having done an excellent job.

A veteran of both World Wars, he became a naturalized citizen in 1916 and was graduated from the University of Wisconsin in 1923.

Long identified with Ordnance, Mr. Slezak brought to a very difficult assignment the prudence, patience, and wisdom which have characterized his work in the military and in industry.

His associates among the officers and directors of the American Ordnance Association and, indeed, the entire membership, extend to him best wishes for continued success in all his endeavors.

Business-Type Government

The United States Chamber of Commerce, Senator John Marshall Butler of Maryland, the Hoover Commission, and the American Ordnance Association are in complete agreement that there should be greater economy and efficiency in Government.

Clem D. Johnson, president of the U. S. Chamber of Commerce, called for a twenty-five per cent slash in Federal spending. He said there were few, if any, Federal agencies that could not "do an adequate job" with one-fourth less money. Less governmental spending would mean further tax relief in this direction.

Mr. Johnson sharply criticized the large number of military commissaries and the use of enlisted personnel to staff them.

He asserted there were five commissaries in Washington alone, each staffed by some seventy enlisted men. Mr. Johnson suggested that two-thirds of the cost could be saved by hiring civilians to do the work of the enlisted clerks.

Senator Butler predicted that some business operations conducted by the Federal Government would be returned to the scope of private enterprise.

"In the interest of an improved national economy and more effective national security," he declared, "the Government and private business will engage in certain partnership ventures.

> *"An illustration of this latter point is found in agreements reached only recently between the Government and one shipping line whereby a fleet of nineteen vessels will be replaced during a 10-year period with some degree of Federal assistance."*

It is quite likely that many of the recommendations of the Hoover Commission will be adopted, marking another steppingstone to greater economy and efficiency in government. During the past year the Hoover Commission has been performing exhaustive studies of many governmental operations, the results of which have gained wide and favorable acceptance not only by Government officials but also by the general public.

The American Ordnance Association, constantly urging thrift, economy, and wisdom in the conduct of all domestic and foreign affairs of our Government, will continue to coöperate with the Hoover Commission to the greatest possible extent. We say, "Throw the red tape out the window!"

National Reserve Plan

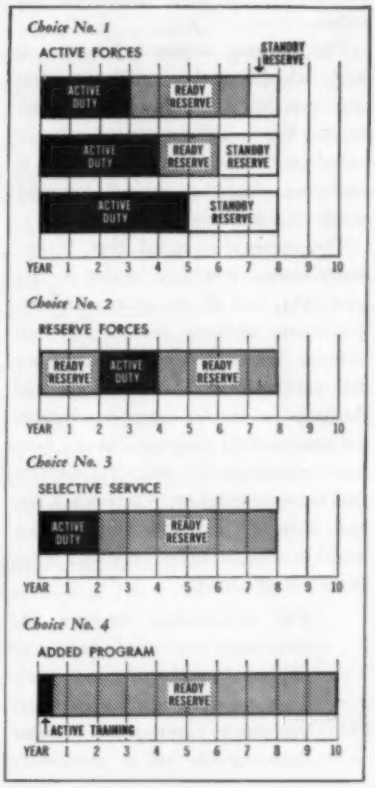
A new program to strengthen the Nation's military reserves by providing an additional Reserve manpower pool of 100,000 during the first year, at a cost of approximately $425 million over the $700 million now being spent, was submitted to Congress in January.

> *According to top Pentagon officials, in these troubled times when military strength is necessary to defend our freedom if attacked, our Nation has but two alternatives:*

1. To maintain huge permanent forces of fighting men—which would destroy prosperity, cripple our productive economy, and be alien to our philosophy, or

2. To develop and maintain a Reserve force of civilians trained in the techniques and tools of modern warfare—civilians who would receive training while continuing their normal activities.

We now have a permanent military establishment to serve as a fighting nucleus in an emergency.



Four choices of service are available under the National Reserve Plan.

But we need to expand the present Reserve training program. We must have a large, well-trained force immediately available if needed. We must have an additional group of men with a background of military training who would be available as mobilization progressed.

The immediately available force would be the new Ready Reserve. A second group would constitute the Nation's new Stand-by Reserve.

Both groups would contain men with military-service obligations. Ready Reservists would be subject to continued Reserve training activity. Stand-by Reservists would be men who had completed stated periods of Reserve training requirements or had spent sufficient time on active military duty.

> *Ready Reservists would be subject to recall in the event of a national emergency proclaimed by the President or declared by Congress. Stand-by Reservists would be subject to selective recall, but only in the event of a national emergency declared by Congress.*

Under the proposal, induction for military service would be continued, and all physically and mentally qualified young men would be subject to call upon reaching 18½ years of age. All men entering the armed forces, whether through induction, enlistment, or appointment, would assume a continuing military obligation.

But within the framework of this program, four choices (see accompanying chart) would be available to all young men. Thus they could select the method of fulfilling their obligation most suited to their career plans.

Choice No. 1.—Enlistment in the Regular component of one of the armed services for periods of three, four, or six years. These men would incur an 8-year military-service obligation.

Choice No. 2.—Enlistment in the Reserve program of the Navy or Marine Corps, with the understanding they will be called to serve a minimum of two years' active service within twenty-four months of enlistment. This also requires an 8-year military-service

obligation, and men must make this choice prior to reaching age 19.

Choice No. 3.—Wait for induction and assume an 8-year military-service obligation beginning at whatever age inductees may be when called.

Choice No. 4.—Enlistment in a proposed additional program (to be offered by the Army, Marine Corps, and Coast Guard) which would require men to participate in a 6-month training program to be followed by 9½ years of military-service obligation. Choice of this program must be made while candidates are between the ages of 17 and 19. A limited maximum quota would be established yearly for this program.

> *The National Reserve Plan would create a trained force of civilians available in case of emergency or mobilization. It would also:*

1. Provide a fair and equitable method of recall to active service.
2. Allow young men to choose their preferred branch of service and allow them to elect methods by which military service could be performed.
3. Allow them to start fulfilling military-service obligations at an early age, before assuming the responsibilities of family and career.
4. Provide all the material benefits of Reserve training to men with military-service obligations.
5. Fulfill the manpower needs of industry and the community.
6. Retain for free Americans their tradition of voluntary service as citizen-Reserves.

Ammunition Shortages

In March 1953, Gen. James A. Van Fleet returned to the United States and reported to the American people about the serious, and sometimes critical, shortage of ammunition during his twenty-two months of service in Korea. Since that time a Senate Subcommittee on Ammunition Shortages has been investigating our ammunition situation and has published a fourth and final report on the subject.

It was established that there were shortages in certain rounds during the fighting in Korea. These critical rounds were: 60-mm., 81-mm., and 4.2-inch mortar; 105-mm. and 155-mm. howitzer; and the hand grenade. These rounds were vital to the troops on the battlefield.

> *Originally the committee confined its inquiry to these six types. Subsequently the committee examination broadened to include the worldwide ammuntion commitments of the United States.*

The committee found that, after the commencement of hostilities, the production of ammunition had to be generated from a standing start to a position of volume production. New ammunition of some types did not roll off the line for twenty-one months after the Korean war started. This time lag was longer than the planners had anticipated, with the result that available stocks of World War II ammunition were not sufficient to fill the gap.

With the Korean truce, rapid strides were made toward filling the shortages that had existed, not only in Korea but also in our Far Eastern stockpiles, and it was concluded soon thereafter that there was no further deficiency in those areas.

The question persisted, however, as to the schedule and our ability to attain our remaining worldwide commitments. We could no longer rely on withdrawals from our World War II stockpiles which had dwindled considerably due to Korea.

The committee stated that United States troops, wherever located in August 1954, had all the ammunition requirements deemed essential by our military leaders to meet any foreseeable contingency. The Air Force had shortages in certain categories because the ammunition program did not keep pace technologically with the aircraft-development program. There was a lag, and although older-type ammunition could be used, it would be with a lesser degree of efficiency.

> *The ammunition situation, the committee concluded, has vastly improved in the past two years. This improvement is particularly noteworthy among the United States troops on a worldwide basis.*

The ammunition stocks of some of our allies remain in an unsatisfactory position due, in part, to the failure of the offshore procurement program to measure up to expectations.

The general question of military requirements for ammunition will be discussed at length in an early issue of this journal. It is a vitally important subject on which even our defense philosophers, no less than average citizens, are frequently ill-informed.

Management Practice

Selected Ordnance officers are being assigned to civilian industrial corporations to study at first hand the policies and techniques which top management executives of these institutions employ, principally the operations involving production, distribution, research and development, public relations, and fiscal management.

> *This training has as its purpose the preparation of officers for positions of command at arsenals, depots, districts, and proving grounds of the Ordnance Corps, including key staff positions in the Office of the Chief of Ordnance.*

The five corporations tentatively selected to conduct the industrial practice periods are Inland Steel, International Harvester, Borg-Warner, Motorola, and Sears Roebuck.

The Ordnance officers will spend three months in each of the five participating corporations. A terminal period at Ordnance district headquarters will serve as a practice session during which the officers will be given actual task assignments selected from the current work load of the district and required to complete the assignments as though actually on duty.

In addition to the industrial management practice phase of the training, these officers will be enrolled in the executive program of the University of Chicago which meets two evenings each week during the months of October through June in each of the two years.

Excellent idea, say competent observers. It is a program which first proved its value in the Ordnance Department of the Army nearly four decades ago.

Our Vanishing Marksmen

An Editorial

THE spirit of the immortal Annie Oakley, who, when she was twelve years old, could shoot the head off a running quail, doesn't live here any more! Americans in recent years have become the second-best marksmen in the world. The exploits of the keen-eyed nineteenth-century Ohio girl, who once shot the ashes off a cigarette while Kaiser Wilhelm II was holding it in his mouth, are far better imitated in the Soviet Union than in the United States of America.

It is neither a tenet of Marxist ideology nor a bit of capitalist propaganda, but it is a matter of hard common sense that, for all the spectacular modern advances in waging battle with supersonic aircraft and atomic weapons, the man in uniform, whether he plods the earth, sails the seas, or flies the firmament, must—repeat *must*—be a better shot than his adversary.

For all the changes in the strategy and tactics of defense, the marksman is still supreme—even after atomic bombs have done their worst.

Oldtimers will recall when the United States led the field in marksmanship. Today we are has-beens. At least Hitler could paint a barn door. We don't seem to be able even to hit it any more.

LEST it be thought that these harsh and unpalatable verdicts are simply editorial hysteria, let us sit down together and take a look at the January issue of *The American Rifleman*, the journal of the National Rifle Association. It presents a summary of the sad results of the Thirty-sixth World Shooting Championships at Caracas, Venezuela, late last year.

The American heirs of the glorious marksmanship tradition established by Annie Oakley placed fifth in the free-rifle 300-meter event, sixth in the smallbore rifle 50-meter team match, fifth in smallbore rifle competition (prone and kneeling), sixth in the smallbore standing match, second in the free-pistol 50-meter contest, second in the center-fire pistol 25-meter contest, and second in the rapid-fire pistol 25-meter contest. We placed first only in smallbore rifle shooting at 50 and 100 meters and in skeet shooting.

Joe Smith can no longer compete, on equal terms that is, with such socialist shooters as A. Bogdanov and V. Borisov. Have we lost the competitive spirit? Have we become fatter and flabbier, less quick and deadly on the draw?

Let us have a word from Maj. Gen. M. A. Edson, U.S.M.C. (Ret.), chief of the United States delegation. General Edson's lead editorial in the January issue of *The Rifleman* is entitled "A Bastion of Strength."

"Our relative position with respect to other teams was much the same as in 1952," the general observes, with this exception: "The Union of Soviet Socialist Republics was not represented in the matches at Oslo, whereas there was a very strong Russian contingent at Caracas.

"When the smoke cleared away, the Russians had amassed the amazing total of nine team and eight individual championships—all but three of them with new world records. This was an exhibition of shooting skill that was beautiful to watch and a challenge to every individual who believes in the fun—and the serious aspects—of competitive shooting as one of the factors in marksmanship proficiency.

"How did this come about? To those who know competitive shooting, I believe the answer was obvious. Certainly their team had no better equipment than that of other nations. In fact, some weapons and some of the ammunition was of the same manufacture as that used by the U. S. team. Although the men were individually and collectively excellent shooters, none of them were 'supermen.' There were any number of other competitors who are potentially as good or better than their best.

"The real answer lies in the importance which the Russians attach to winning any competitive event they enter —and the methods they follow to achieve that objective.

"In the same manner as the United States Marine Corps used to build its basic marksmanship and competitive programs with our National Rifle Matches in mind, so did the Russians set their sights on the 1954 World Championships. Just as a Marine who showed ability in local post tournaments went on to division or regional matches and then to the Marine Corps Championships and a chance for a berth on the 'Big Ten' at Perry—so did the Russians progress from the local level through civic, provincial, and state tournaments to a place on the National Shooting Team."

What about marksmanship in our own services? The meager information is not encouraging. This is a polite way of saying that it is highly discouraging. There is elsewhere apparent a diminishing emphasis on small arms.

But in its training schedules at least, the Army has returned to first principles and now tries to train marksmen. Any young man who joins must spend at least 319 hours during his two years in uniform studying and firing his rifle.

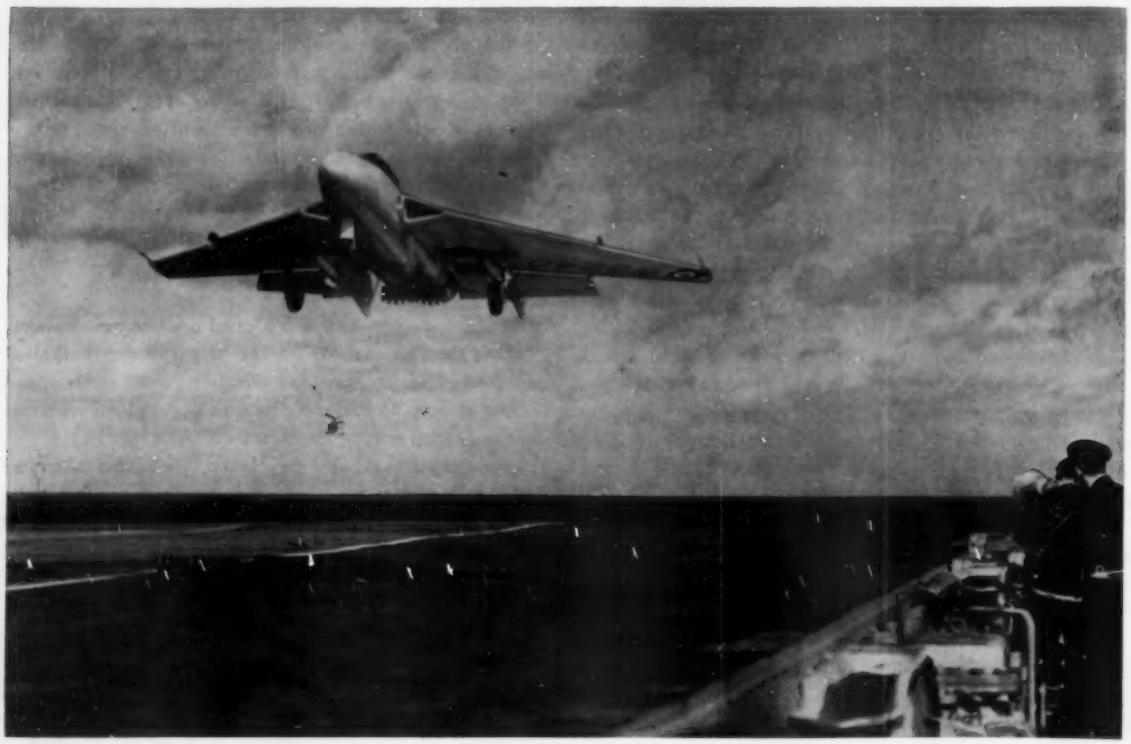
THE new policy—and it is a good one—seems to underscore the idea that we do not have vast and unlimited quantities of ammunition and therefore cannot easily afford to blast or burp an entire enemy province without once taking aim at what may be the enemy.

Rather than bankrupt the Nation, competent observers feel very strongly that marksmanship training should be increased to 638 hours across the board—Army, Navy, and Air Force.

We have the best small arms and the best small-arms ammunition the world over. We must be jealous of our supremacy not only in the design and manufacture of small arms and ammunition, but we must also regain our lost supremacy as marksmen at all costs. More power to General Edson and the N.R.A.!

British Aircraft Developments

The British Navy has developed the rescue net, above, which allows a helicopter to fish disabled or unconscious men from the sea when the usual sling method is impracticable. Below, the new De Havilland 110 two-place supersonic jet fighter lands on the angled deck of H.M.S. ALBION with the aid of a new mirror landing device which replaces the signal officer (British photos).



ASSOCIATION AFFAIRS

Australian Ambassador Addresses Meeting of the Washington Post

The December luncheon meeting of the Washington Post was held at the National Press Club on January 16th with His Excellency Sir Percy Claude Spender, K.B.E., Q.C., Australian Ambassador to the United States, as the guest speaker.

A noteworthy event, the presentation of an honorary life membership to Norman K. Haig, was an added attraction at this meeting. Mr. Haig, an official of the General Motors Corporation and for many years an enthusiastic supporter of the A.O.A., was praised by Col. Leo A. Codd, executive vice-president of the Association, who reminisced on the many achievements of Mr. Haig in advancing the cause of ordnance among industrialists.

Lieut. Gen. Levin H. Campbell, Jr., president of the A.O.A., presented the life membership certificate and lauded Mr. Haig for his interest in the ideals of the Association.

Colonel Codd then delivered a splendid tribute in praise of the outstanding leadership that General Campbell has given the A.O.A. during the past two years as president. It was the last public appearance the general made at an Association meeting before Vice Adm. George F. Hussey, Jr., assumed the presidency on January 1, 1955.

Colonel Codd pointed out that never in its history has the A.O.A. been as strong in peacetime in number of members, effectiveness of the Technical Divisions, and finances—for all of which General Campbell is due everlasting credit. It was a stirring and well-timed commentary.

George M. Riveire, president of the Post, introduced the guest speaker, Sir Percy Spender. The Ambassador from Australia delighted the audience with a most interesting discussion of world affairs. He noted that Russian foreign policy has not changed over many years, that we are frequently misled by changes in her tone and methods, overlooking the fact that her objectives and ideology have remained firm.

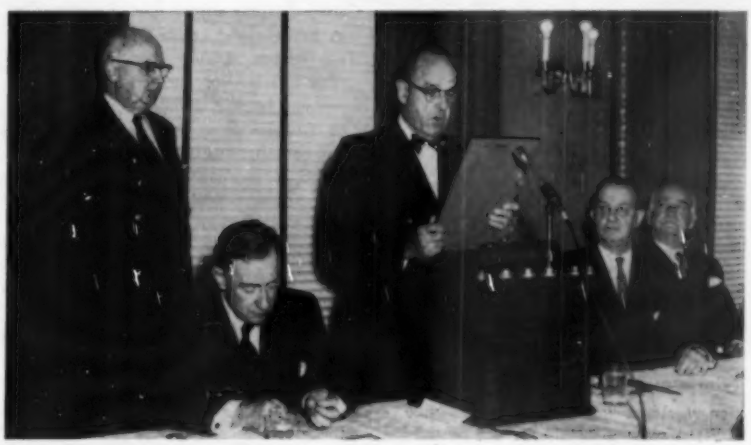
He pointed out that to combat Russia's ever-existent desire to expand her frontiers and influence, the Western nations must strive continually to find common policies and objectives—a difficult task. For example, although the "friendly nations" are in broad agreement on the objectives in Europe, they have overlooked and failed to define objectives in Asia, an equally vital area.

Peace in Asia and Europe are tied together, and Sir Percy pointed out that it was as urgent, therefore, to "get our lines straight" in Asia as it was in Europe. He recognized that methods and means to carry out objectives in Asia are quite different from those used in the West and expressed the hope that if the free world maintains its strength over a long period of time it can avoid war and, through a peaceful example and way of life, may lead the world to better things.

Others at the speakers' table were: Maj. Gen. E. L. Cummings, Chief of Ordnance, United States Army; Maj. Gen. R. L. Maxwell, president of the New York Post and vice-president, American Machine & Foundry Company; Maj. Gen. Robert W. Burns, Assistant Vice Chief of Staff, United States Air Force; W. J. Sears, Rubber Manufacturers Association; Maj. Gen. C. T. Harris, U. S. Army, Ret.; Lieut. Gen. W. L. Weible, Deputy Chief of Staff for Operations and Administration, United States Army; Adm. D. B. Duncan, Vice Chief of Naval Operations; Karl J. Ammerman, Borg-Warner Corporation; Brig. Gen. Urban Niblo, deputy commandant, Industrial College of the Armed Forces; and Brig. Gen. Donald Armstrong, U. S. Army, Ret.

Again in Washington on January 20, 1955, almost 200 members of the Post gathered for their monthly luncheon meeting to honor Maj. Gen. G. B. Montgomery, Commanding General, Eighth Air Force.

Mr. Riveire presided and introduced the distinguished guests at the speakers' table: Lieut. Gen. L. L. Lemnitzer, Deputy Chief of Staff, United States Army; Maj. Gen. W. T. Eckert, Assistant Deputy Chief of Staff, Development, United States Air Force; Rear Adm. Lloyd Harrison, Deputy Chief, Navy Bureau of Aëronautics; Maj. Gen. H. B. Thatcher, Assistant Deputy Chief of Staff, Development, United States Air Force; Maj. Gen. J. E. Briggs, Assistant Deputy Chief of Staff, Operations, United States Air Force; Maj. Gen. R. C. Lindsay, Director of Plans, United States Air Force; Rear Adm. G. C. Weaver, Vice Chief of Naval Material; Brig. Gen. W. E. House, Office, Chief of Ordnance, United States Army; Brig. Gen. T. P. Gerrity, Director of Procurement and Production Engineering, United States Air Force; Col. Ludlow



General Campbell, center, reads life membership certificate honoring Norman K. Haig, left, as Sir Percy Spender, G. M. Riveire, and Maj. Gen. C. T. Harris look on.

King, Universal Moulded Products, past Post president; and Karl J. Ammerman, Borg-Warner Corporation, Post vice-president.

Mr. Riveire then introduced General Montgomery who presented an excellent picture of the growth and operations of the Strategic Air Command.

He compared the bombing effectiveness of World War II with the tremendous power of our present Strategic Air Command where one bomber with a nuclear weapon is the equivalent of about 1,000 World War II bombers.

His talk was made especially interesting by excellent slides picturing the elements that make the Strategic Air Command such a powerful organization, and his presentation gave the members great confidence that our strategic air forces are in capable hands and fully prepared.

• **AT EGLIN AIR FORCE BASE.**—The Florida Post met on January 10, 1955, at the Shoreline Hotel in the first A.O.A. Post meeting of the new year. A sizable turnout of members and guests was on hand to hear Henry S. Gibson, training manager of the Silas Mason Company, describe operations of a 3.5-inch mechanized rocket-loading line.

This equipment at the Silas Mason Cornhusker Ordnance Plant at Grand Island, Nebr., provided a fine example of the problems faced by industry in combining automatic operation with the hazards of handling explosives.

Post officers and directors for 1955 were announced at the meeting and included Col. Paul S. Bechtel, reëlected president, and Lieut. Col. Louis Schaffer and Edward W. Clarno, vice-presidents. Maj. Kenneth E. Brown and John J. Murphy will continue as secretary and treasurer, respectively.

New directors elected to replace those whose terms expired are Capt. John H. Blakelock, F. Kent Serkland, Alf T. Clausen, Lieut. Col. Jan M. Laitos, and Walter Spence.

• **AT ALBUQUERQUE.**—A preliminary meeting of all members in the area was held at the University of New Mexico, on January 13th to hear Rear Adm. W. W. Juvenal, of the Atomic Energy Commission's Santa Fe Operations Office, discuss the participation of the A.O.A. in national defense. The good attendance showed that an effective A.O.A. organization would be welcome in New Mexico.

Plans were then laid for the official inaugural meeting of the Albuquerque Chapter of the Rocky Mountain Post.

Col. Herbert A. Gidney Has Long Record of Service to Association

Col. Herbert A. Gidney, who has been a vice-president of the A.O.A. since January 1946, has declined to accept another term as vice-president in order to "let some of those young fellows have the opportunity to work."

Colonel Gidney is a charter member of the Association since its founding in October 1919 and is also a life member. He was a founding director of the Pittsburgh Post in 1927 and president of that Post from 1935 to 1945. In 1940 Colonel Gidney was elected a national director, and in 1946 he was awarded the Scott Gold Medal of the Association for distinguished service to ordnance at a ceremony in Washington at a meeting of the national Councilmen where Maj. Gen. Everett S. Hughes, then Chief of Army Ordnance, made the presentation on behalf of the Association.

From the time of Col. James L. Walsh's death in June 1952 until the election of Lieut. Gen. Levin H. Campbell, Jr., in December 1952, Colonel Gidney served as acting president of the Association. Since his retirement from the Gulf Oil Corporation, Colonel Gidney has divided his time between his home in Hyannis Port, Mass., and Florida. He frequently visits his old headquarters in Pittsburgh in his capacity as a consultant to the Gulf Oil Corporation.

There is no more faithful and loyal member of this organization, and much of its growth and strength can be attributed to his constant interest through the years. He will continue to serve as a member of the Board of Directors where he has always helped to guide the A.O.A. with good judgment and wise counsel. (See photograph on page 713.)

• **AT SEATTLE.**—The board of directors of the Puget Sound Post met on January 4th to receive the report of the nominating and election committees. The following new officers and directors were announced: President, Joseph A. Denn; vice-presidents, Col. Marmion D. Mills and Paul Forsyth; secretary-treasurer, Fairman B. Lee; directors, Robert Hutchinson, Ed Hemb, Lyle Wood, Blake Mills, L. A. Williams, Guy L. Chilberg, Leon E. Titus, Henry Fairbairn, and Ernest Jones.

Before adjourning, plans were discussed for a spring meeting when a visit to McChord Air Force Base is under consideration.

• **AT INYOKERN.**—The Inyokern, Calif., Chapter of the Los Angeles Post was inaugurated at the Naval Ordnance Test Station on December 13, 1954.

The charter for the new Chapter was presented by R. C. Geffs, president of the Los Angeles Post, to Kelvin H. Booty, head of the engineering department, NOTS, first chairman of the new unit. Prior to the presentation, a telegram from Lieut. Gen. Levin H. Campbell, Jr., national president of the A.O.A., was read to the new members, welcoming them into the national organization.

Capt. D. B. Young, commanding officer of the test station, greeted the gathering, promising his support and wishing the Chapter the greatest success.

Al Gould, Ken Robinson, and Carleton Horne were elected as vice-chairmen. After the meeting, plans were discussed for a 2-day session at Inyokern for the entire Los Angeles Post to be held about the middle of April.

• **AT LOS ANGELES.**—A number of the members of the Los Angeles Post joined with representative organizations of industry in the area on December 8, 1954, in sponsoring a small dinner meeting to honor Under Secretary of the Army Frank Higgins and Lieut. Gen. W. B. Palmer, Deputy Chief of Staff for Logistics.

The two guests of honor had just completed an inspection tour of the area, utilizing helicopters furnished by the U. S. Marine Corps to travel from plant to plant. At the dinner they praised the splendid coöperation of the industrial firms in the Los Angeles area, and each reported on the scope of his present duties in the light of the new reorganization plan of the Army.

The A.O.A. members present were delighted with this opportunity to honor two members of the Army who have so often taken an interest in Association affairs.

• **AT DETROIT.**—The Michigan Post's Annual Dinner Meeting on December 8, 1954, drew a large crowd of enthusiastic members and guests.

Charles L. Jacobson, Post president, presided at the meeting and after the dinner introduced Robert L. Biggers, national vice-president of the A.O.A. for Posts and Chapters. Mr. Biggers as toastmaster presented Maj. Gen. James M. Gavin, Assistant Chief of Staff for Op-

erations, United States Army, who was the guest of honor and principal speaker.

The general reviewed world conditions and outlined the various courses of action that were open to this country to maintain our status in a free world. He told of the Army's part in and contributions toward insuring a strong national defense. General Gavin's complete address is published on page 716 of this issue.

At this meeting the slate of nominations of officers and directors for 1955 was announced, and the following have subsequently been elected: president James K. Fulks, Ex-Cell-O Corp., Detroit, Mich.; Vice-Presidents Herbert R. White, Eclipse Counterbore Company, Ferndale, Mich., and Elisha Gray, II, Whirlpool Corporation, St. Joseph, Mich.; Secretary-Treasurer Charles W. Brownell, National Bank of Detroit, Detroit, Mich.

The following new directors were elected to replace those whose terms had expired: Raymond R. Eppert, Burroughs Corporation, Detroit, Mich.; Mr. Gray; Del S. Harder, Ford Motor Company, Dearborn, Mich.; Thomas F. Morrow, Chrysler Corporation, Highland Park, Mich.; and Fred W. Parker, Jr., Timken-Detroit Axle Division, Detroit, Mich.

San Francisco Post Directors Elect Lawrence S. Fletcher as President

Lawrence S. Fletcher was elected president of the San Francisco Post for 1955 at a meeting of the Post's board of directors held at the Pacific Union Club in San Francisco on December 17, 1954.

Other officers were elected as follows: First vice-president, A. B. Layton, Crown-Zellerbach Corporation, San Francisco; second vice-president, J. M. Hait, Food Machinery and Chemical Corporation, San Jose; and secretary-treasurer, Col. John M. Stark, commanding officer, San Francisco Ordnance District, Oakland.

Mr. Fletcher is a partner in the law firm of Hardin, Fletcher, Cook & Hayes and a director of Lyco Machine Works.

At the board meeting, the election by mail ballot of three new members of the Post's board of directors was announced: Maj. Gen. Lawrence C. Ames, Air National Guard, a partner in the Irving Lundborg Company; William E. Waste, executive vice-president and general manager of the Pacific Gas & Electric Company; and Fred B. Whitman, president, Western Pacific Railroad Company—all of San Francisco.

Retiring board members of the Post are Mr. Greenwood; B. C. Heacock, retired president and chairman of the board of the Caterpillar Tractor Company; and Adm. George D. Murray.

L. S. Fletcher, new president, left, chats with G. M. Greenwood, retiring president.

• AT SYRACUSE.—The Syracuse Chapter of the Empire Post held its annual dinner meeting on November 23, 1954, at the Hotel Onondaga.

Lieut. Col. Matthew R. Collins, chief of the Guided Missile Section in the Ordnance Research and Development Division, Office of the Chief of Ordnance, was the guest speaker. Colonel Collins presented a clear outline of research and development objectives and standards, particularly as they apply in the guided-missile field.

At the business meeting the following officers and new vice-chairmen were elected for the coming year: chairman, Paul L. Christensen, Onondaga Pottery Company, Syracuse, N. Y.;

First vice-chairman and meeting chairman, Richard W. Noyes, research engineer, Oneida, Ltd., Oneida, N. Y.;

Second vice-chairman and membership chairman, Gustav F. Watters, Niagara Mohawk Power Corporation, West Syracuse;

Secretary, Gwyn Thomas, Manufacturers' Association of Syracuse;

General vice-chairmen: William A. Gabrielson, Smith-Corona, Inc., Syracuse; Joseph F. Kerigan, New Process Gear Corporation, Syracuse; and George Lilygren, Carrier Corporation, Syracuse.

Association Affairs

Posts and Chapters

• AT BIRMINGHAM.—Rear Adm. Wendell G. Switzer delighted the members of the Birmingham Post with a brilliant account of naval aviation developments at the Annual Dinner Meeting on December 8, 1954, after a full day devoted to Ordnance affairs.

The Birmingham Ordnance District Office held open house all day for industrial members of the Association. Lieut. Col. F. W. Aungst was host in the temporary absence of Col. H. G. Lang, deputy district chief. In the afternoon, many members journeyed to Fairfield to inspect the Tennessee Coal & Iron Division plant of United States Steel Corporation.

In the evening about 200 members and guests from this industrial stronghold of the South assembled at the Dinkler Room of the Tutwiler Hotel to reaffirm their allegiance to the Industry-Ordnance Team. After the reception, the dinner meeting was called to order in the grand ballroom by A. V. Wiebel, Post president and president of Tennessee Coal & Iron Division.

After dinner Mr. Wiebel speedily concluded Post business—a unanimous approval of the new slate of Post officers and directors for 1955—and introduced the guests at the speakers' table.

Admiral Switzer, commander of the Naval Air Technical Training Center, Memphis, Tenn., presented a concise and most interesting account of latest developments in naval aviation and concluded with a strong plea for civic coöperation to reduce the enormous turnover of technically trained enlisted men.

Admiral Switzer interspersed his talk with entertaining yarns of the unexpected antics of early missiles. His picture of the technical personnel situation, applicable to all three services, was a gloomy one. Only four per cent of specially trained men in the Navy are reënlisting after four years, two of which were required for training.

Posts and Chapters

Prior to the evening gathering, the officers and directors met to hear the treasurer's report and accept the nominating committee's slate of the following officers for 1955: president, Warren Whitney, vice-president, J. B. Clow & Sons; vice-president, Claude S. Lawson, president, U. S. Pipe and Foundry Company; treasurer, Robert D. Cotten, Clark-Cotten Mortgage Company; secretary, Ralph E. Parker.

LIEUT. F. W. G. LESLIE WINS $1,000 PRIZE IN WALSH ESSAY CONTEST

The American Ordnance Association was pleased to inform Lieut. Frederick W. G. Leslie of Washington, D. C., that he had submitted the winning essay in the James L. Walsh $1,000 prize essay contest.

Writing on the subject, "Industrial Mobilization as a Vital Factor in National Defense," Mr. Leslie based his paper on the theme that there is no more important industry than our own national defense.

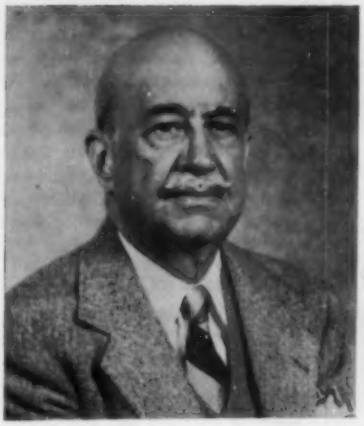
He discussed the areas where increased emphasis is needed to bolster our preparedness and pointed out that the office of the Secretary of Defense has the authority to implement those functions that appear to require more emphasis.

Lieutenant Leslie is an assistant professor on the faculty of George Washington University Law School, Washington, D. C.

He was born in New York City in May 1926 and was educated at Stanton Military Academy and at Harvard University. After two years of active service in the Army, he completed his education with courses at Cambridge University, England, and at Harvard where he received his A.B. degree, and then transferred to Columbia University School of Law for his LL.B.

Lieutenant Leslie's Army service from 1944 through 1946 was with the 3d Infantry Division, Mechanized Reconnaissance Troop, in the European theater. Since his discharge from the Army he has been active in Army Reserve officer training, was commissioned a second lieutenant of artillery in 1948, attended the Artillery School, Fort Sill, Okla., during the summer of 1950 and the Antiaircraft and Guided Missile Branch Artillery School in the summer of 1951. Commissioned a first lieutenant in 1953, he is now attached to the 300th MG Group in Washington, D. C. Lieutenant Leslie is a member of the bar of New York State, the District of Columbia, and the United States Court of Military Appeals.

Death Claims Two Ordnance Stalwarts, Maj. C. S. Comeaux and E. T. Gushée



Maj. C. Stewart Comeaux

Edward T. Gushée

Maj. C. Stewart Comeaux, a national director of the American Ordnance Association and former president of the Association's New York Post, died at his home, Coronado, in Oklawaha, Fla., December 10, 1954. He had recently returned home from the annual directors' meeting of the Association in New York. He was a charter member of the Association, a lifelong leader in the explosives and small-arms industries of the United States.

Major Comeaux was born at Bayou Goula, La., December 6, 1889. He studied law at Louisiana State University after which he entered trade-association work. He formed the Institute of Makers of Explosives in 1913, serving as executive secretary and treasurer until his retirement in 1952. He also organized the Sporting Arms and Ammunition Manufacturers' Institute in 1926.

Long a member of the Officers' Reserve Corps, Major Comeaux was called to active duty in the Second World War as a special assistant to the Chief of Ordnance. His broad acquaintance throughout industry and his superb managerial ability were of outstanding worth in the success of the vast ordnance program of those times.

Few equaled Major Comeaux in his loyalty and zeal for the national defense of the United States. Throughout his entire life his abilities and energies were devoted to the advancement of industries closely associated with national-defense progress.

He possessed in abundant measure those gentlemanly traits which are the mark of a good citizen. All his relationships were guided without thought of personal advancement but with only a deep attachment to God and to country.—L.A.C.

Edward T. Gushée, vice-president of the Detroit Edison Company and one of the architects of the American Ordnance Association, died at Detroit on December 15, 1954, after a short illness. Chief of the Army Ordnance District at Detroit and formerly a president of the Michigan Post of the Association, Mr. Gushée was one of the best-known and best-loved members of the Ordnance fraternity.

He was born in Los Angeles, Calif., January 10, 1895, and was graduated from the Kent School in Connecticut after which he attended Pomona College. Following his service as a captain of Infantry in the A.E.F. during World War I, he began his service with the Detroit Edison Company in 1920, marking a long period of important leadership in the electric power industry.

He was called to Washington early in 1942 to serve on the staff of Lieut. Gen. Levin H. Campbell, Jr., Chief of Ordnance of the Army, where he rendered outstanding service as chief of the Purchase Policy Branch of the Department. Later he returned to the Detroit Edison Company as assistant to the president and subsequently assistant to the chairman of the board. He was reëlected a vice-president of the company as of January 1948.

Mr. Gushée served as a member of the Army Ordnance Advisory Board of the Detroit Ordnance District, as chairman of the Detroit Area Production Urgency Committee, and as a member of the Labor Priorities Commission of the War Manpower Commission.

In all his contributions to the national welfare, he displayed integrity, sincerity, and prudence for which the Association is the better and its objectives the more secure.

Metal Working Lubricants Committee Meets at New York Naval Shipyard

The Metal Working Lubricants Committee of the A.O.A. Advisory Technical and Research Group held its sixth meeting at the New York Naval Shipyard, Brooklyn, N. Y., on November 18, 1954. Chairman William J. Reitze opened the meeting with thirty-one members and visitors present. George W. Gleim, secretary of the Committee, was on the job as usual.

Capt. B. G. Lowrey, U.S.N., assistant commandant of the Yard, welcomed the Committee and described briefly the work under way.

David N. Smith, of Jones & Lamson Machine Company, discussed "Metal Cutting Test Techniques," and showed a colored movie of high-speed metal cutting. A feed load rating is not used for determining tool changes; rather, a piece count is used and a wear land of about 0.020-inch is practical when considering tool grinding.

Studies show that surface damage changes with cutting speed, but whether the damage is from tearing and welding or from actual heat treatment of the surface due to heat of cutting has not been determined. In cutting titanium the rake angle is very critical. The feed load is about fifty per cent of that obtained on high-alloy steels. In cutting titanium, the correct rake angle is very critical. The feed load is about 50 per cent of that obtained on high-alloy steels.

The vertical dynamometer loads increase from 5 to 10 per cent during the cut, the feed increases from 50 to 100 per cent, and the radial loads from 200 to 300 per cent. The dynamometers are so sensitive that chip-outs can be located during the cut. The feed load is the best method of control for tests.

L. H. Sudholz reported for the Cutting Oil Test Subcommittee. The final report from this Subcommittee will contain a list of the titles of the papers together with an abstract of each and a summary showing cost of equipment, availability, and reproducibility of the test.

Melville Yancy reported that information has not been received from those activities trying out the suggested lubricants for dimpling.

Joseph R. Volmer reviewed the problem of heavy forging lubricants. Battelle Institute has started work on this problem and has issued two interim reports. They use a small flat die scaled to the larger machine. Using a bulging index they record loads on softer metals; *i.e.*, 14S aluminum at 125 degrees Fahrenheit. Die temperature is very important, and the bulging index drops off between 500 and 900 degrees Fahrenheit, with magnesium behaving very similarly to the aluminum.

None of the five lubricants tried were promising. The best is an ester plasticizer at 700 degrees Fahrenheit. The nitrides are least affected by temperature. Graphite worked well on aluminum under 18,000 tons' pressure, but the problem calls for much higher pressures.

Compounds for either hard or soft steels did not work at all on aluminum or magnesium. Cold extrusion improves steel characteristics—the greater the pressure the easier the extrusion.

M. E. Dougherty read an M.I.T. report on "Friction Characteristics of Titanium." Glass was first found to be a suitable lubricant in tube-forming titanium, but later Bonderite SS with a regular stainless steel drawing compound worked equally well. A round-table discussion on "Drawing of Titanium" will be held at the next meeting.

The following list of articles was recommended: 1. "Forming of Titanium," *Rem-Cru Titanium Review*, July 1954; 2. "Titanium," *Magnesium Magazine*, May 1954; 3. "Forming Titanium," *Modern Metals*, September 1954; 4. "How to Work Hot Titanium," *Steel*, May 1954.

The problem of "Machining 300 Series Stainless Steel" was discussed. For turning, 450 feet was high or just about top speed for this metal until very recently. Water-soluble coolants with wetting agents were considered satisfactory as lubricants. For milling, 450 feet seemed to be much too high. Climb cutting might improve performance. For threading and tapping, a high-sulfur, high-chlorine cutting fluid was recommended. Too much sulfur may increase tool wear.

For cutting tools, Mr. Smith reported that the cast-iron grades of carbide are more successful at speeds below 200 to 300 surface feet a minute and that steel grades of carbide are better at higher speeds. Recently, 347 stainless and Worthite have been put in production at speeds of 500 to 600 surface feet a minute with water-soluble coolants plus wetting agents.

The equipment necessary for running core oil evaluations cannot be obtained and at the request of Mr. DeNeale this subject was dropped until the Naval Gun Factory reopens it.

Under miscellaneous matters it was reported that broache were being ground using CO_2 as a coolant with no metallurgical changes taking place. An aqueous solution of Teflon, described in Du Pont Bulletin X-58, is being used as a coolant. Its coefficient of friction is 0.25 versus 0.8 for molybdenum disulfide.

It was found to be the only material that would work on one die problem. In this connection, the health problem involved when teflon is heated was discussed.

After the meeting, a fine luncheon was enjoyed at the Officers' Mess followed by a conducted tour of the shipyard. The subassembly shop and the U.S.S. SARATOGA were visited.

This was a fine technical session—it was well organized, industry was well represented, and the discussions were lively and to the point. Congratulations from A.O.A. headquarters for a fine job!

PROPELLANTS AND EXPLOSIVES COMMITTEE HOLDS CLASSIFIED MEETING AT PICATINNY

The Propellants and Explosives Committee of the Advisory Technical and Research Group held a classified meeting at Picatinny Arsenal on November 30, 1954, with Cochairmen F. M. Hakenjos and C. H. Carter, Jr., presiding.

Col. J. A. Barclay, commanding officer, Picatinny Arsenal, welcomed the Committee and guests. He stressed the long period in which Industry-Ordnance relations in the field of explosives have been happily fostered through the Committee.

S. Sage gave an excellent report on the propellants activities at the Quebec Tri-Partite Conference last fall. L. Eriksen discussed the explosives activities at this same conference in an equally effective manner.

Col. Robert Meals, Ordnance Ammunition Center, Joliet, Ill., discussed Integration Committee activities. He stressed the restrictions imposed upon its operations by the antitrust laws and the care that must be exercised to avoid difficulties in this connection.

Brig. Gen. Joseph M. Colby, commanding general of Frankford Arsenal, Philadelphia, Pa., discussed informally the operations of the Off-Shore Procurement Office in Europe. In particular, the manner in which European industry entered into contracts for items and how they improved their production methods and procedures with corresponding reduction in contract prices proved most interesting.

Lieut. Col. H. B. Kucheman, Jr., Air Armament Center, Eglin Field, Fla., gave an interesting account of the problem of "Flameout in Jet Aircraft Operations," with probable causes, steps taken to correct it, and forecasts as to what may be expected in the future.

The meeting then passed to general discussion of the following subjects: (1) Ordnance program for meeting requirements for raw and intermediate products; (2) Selection of a suitable process for making nitroguanidine; (3) Retention of

know-how during reduced procurement periods; (4) Application of continuous mixing techniques in the manufacture of solid propellants; (5) Current status of sulfate wood pulp program; (6) Adequacy of RDX supply.

Chuck Carter announced his resignation from the position of cochairman and as a member of the Committee due to a recent assignment to nonrelated work by his company.

The Committee agreed to by-laws proposed to it, whereby the use of cochairmen was eliminated and a chairman and deputy chairman substituted. F. M. Hakenjos, Hercules Powder Company, was elected chairman and J. J. O'Neill, Olin Mathieson, deputy chairman, for the following year. The by-laws contain provisions for a total membership of fifteen, with five elected each year, replacing five outgoing members. The deputy chairman is elected each year to serve one year and succeed to the chairmanship the following year. Chairmen and members cannot succeed themselves but may be reëlected or reappointed after a lapse of one year.

It is believed that this provision for regular turnover in membership and officers of the Committee will make for a healthier and more effective group. These by-laws were approved with minor changes by Louis Polk, the vice-president in charge of Technical Divisions and Committees, as provided in the A.O.A. by-laws. Chairmen, deputy chairmen, and members of this Committee, according to these by-laws, are appointed subject to the approval of the vice-president in charge of Technical Divisions and Committees and the general chairman of Divisions and Committee.

After the meeting adjourned, an excellent refreshment hour and a fine buffet dinner served in the conference hall were enjoyed by all present.

Instrument Precision Ball Bearings Committee Discusses Torque Testing

The Instrument Precision Ball Bearings Committee of the Fire Control Instrument Division held a meeting at the Engineers' Club, New York City, on December 8, 1954. Chairman F. E. Ericson called the meeting to order at 10:00 a.m. with 35 members and guests present.

The chairman presented the military standard, "Friction Torque Testing for Instrument Antifriction Bearings," received from the Staff Director for Standardization of the Department of Defense, which had been sent for study. It was decided to reactivate the Torque Subcommittee to consider this standard and present a report to be forwarded to the Department of Defense by April 1, 1955.

K. D. Mackenzie of the Vibration Subcommittee reported problems concerning technical details surrounding pickup units.

The chairman opened discussion on the scope of standardization of instrument precision ball bearings. He felt that the A.O.A. Committee should not in any way infringe upon the prerogatives of the Annular Bearing Engineers Committee. He felt that A.O.A. should make suggestions to A.B.E.C. as to standardization in those fields where predominance of application was not in the instrument field, and that in those fields (*i.e.,* Class 5) where instrument application was predominant, the A.O.A. Committee should decide on the standards.

In discussing the definition of instrument precision ball bearings as adopted by the Subcommittee on Technical Standardization, comment from several members indicated a definite trend toward higher grades of precision and that functional considerations are actually outweighing dimensional considerations. In the work of the Subcommittee it was reported that radial-play standards had been practically adopted, standardization was proceeding rapidly on miniature sizes and extra-light series bearings, and agreement virtually reached on flange tapered O.D. bearings.

A. E. Rahm, Wright-Patterson Air Force Base, mentioned that Public Law 436, Eighty-second Congress, relating to standardization of components, made a very difficult situation for engineers, particularly where pressure toward miniaturization and higher performance characteristics was exerted.

H. A. Offers commented on the need for realism in respect to producibility of many of the new designs of instruments now being developed, stating that the country could very easily engineer itself out of producible reality, considering requirements for speed and volume in an emergency which could not wait for the solving of unusual production problems. There was general agreement with this comment.

O. C. Fox commented on certain problems he had met in connection with specific quantities of coded groups of ball bearings. Various company members stated that in no case had the unconditional supply of specific quantities of coded bearings been agreed upon in view of the variability of production and the impossibility of manufacturing specifically to a tolerance of only 0.0001-inch on both bore and O.D., and that coded groups were developed only as a random proposition.

This was finally resolved on the basis of a desire on the part of the bearing companies to coöperate in specific instances only, and the chairman was requested to write the proper party in the Air Force regarding this decision.

F. V. Johnson recommended that the Torque Subcommittee get comments on the evaluation of the military standard tester and the Subcommittee discuss the performance with a recognized expert on dynamic performance and analysis.

Following adjournment, an excellent luncheon was served at the Engineers' Club.

GUIDED MISSILE SEMINAR PAPERS NOW AVAILABLE TO MEMBERS IN BROCHURE FORM

A Guided-Missile Seminar was held as a part of the Annual Industrial Preparedness Meeting of the A.O.A. at the Waldorf-Astoria Hotel, New York City, on December 1, 1954. The chairman of the seminar was Louis Polk, vice-president of the American Ordnance Association in charge of Technical Divisions and Committees. The moderator was the Hon. Donald A. Quarles, Assistant Secretary of Defense for Research and Development.

In addition, the Hon. Frank B. Newbury, Assistant Secretary of Defense for Applications Engineering and Chairman of the Guided Missiles Program Survey Committee, Department of Defense; K. T. Keller, former director of Guided Missiles, Department of Defense; and C. L. Eksergian, chairman, Guided Missile, Rocket and Jato Division, A.O.A., were present at the speakers' table.

After a statement of the objectives of the seminar, Chairman Polk introduced Secretary Quarles who gave an address on the general guided-missile program. He was followed by Maj. Gen. L. E. Simon, chief of the Army Ordnance Research and Development Division and Assistant Chief of Army Ordnance, who spoke on the Army's guided-missile program; Rear Adm. J. H. Sides, director, Guided Missiles Division, Office, Chief of Naval Operations, who spoke on the Navy's guided-missile program; and Brig. Gen. J. S. Kelsey, director, Research and Development, Office, Deputy Chief of Staff, Development, United States Air Force, who spoke on the Air Force's guided-missile program.

The papers presented at this seminar have been printed in a separate brochure

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by national headquarters of the Association and are available to those who are interested.

The seminars held under the auspices of the Association at the annual meetings twice a year are creating more and more interest. Of necessity, seminars of this kind must be unclassified, due to security considerations. The subjects covered must be those capable of presentation to a large group and of sufficient interest to draw and hold an audience. In the future, the Association expects to continue to select the best subjects and obtain the leading panelists so that this important technical contribution to the membership may continue.

At the request of the Department of Commerce, the Seminar on Guided Missiles as presented at the Annual Industrial Preparedness Meeting of the A.O.A. was repeated on December 9, 1954.

Fuze Committee Hears Papers at Closed Meeting in Chicago

The Fuze Committee of the Bomb and Artillery Ammunition Division, under the chairmanship of J. E. Burke, held a classified meeting at the Lake Shore Club, Chicago, on December 14, 1954. The Committee and guests were welcomed by Col. Lyman F. Stangel, chief of the Chicago Ordnance District.

M. Bornstein, Picatinny Arsenal, presented a paper on the "Transition of Fuzes from Development to Production."

Brig. Gen. J. B. Medaris, Assistant Chief of Army Ordnance and head of the Industrial Division, Office of the Chief of Ordnance, gave an informal talk on the two subjects, "New Concept in the Organization of the Ordnance Corps and the Effect on Industry," and "Current Concept of Mobilization Planning in Ordnance and Industry."

He described the "middle-management concept" whereby decentralization from Washington to the field along commodity lines is the practice. Top management remains in Washington, in the Office of the Chief of Ordnance, middle management is in the commodity commands and arsenals which have national missions.

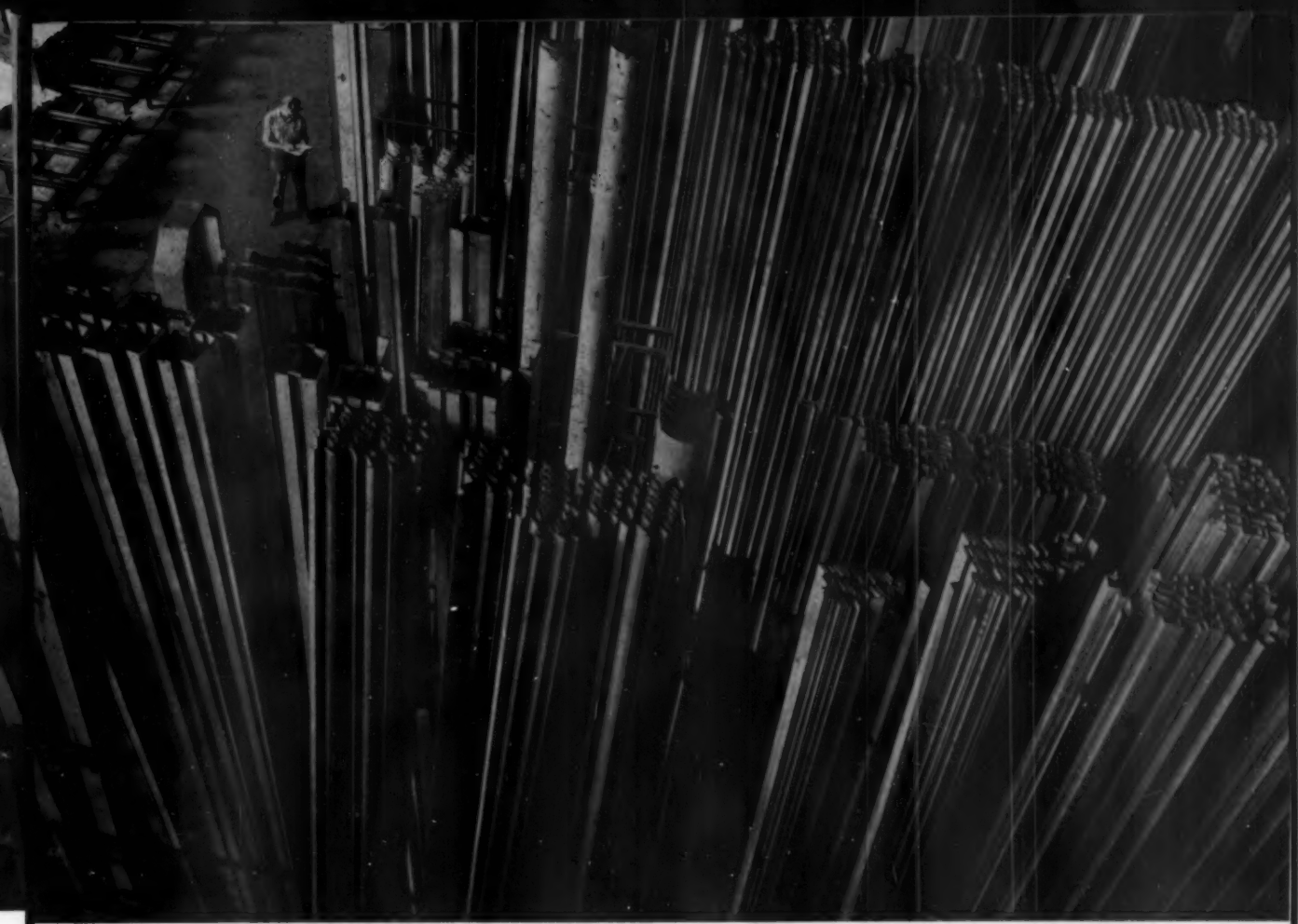
D. E. Marlowe, U. S. Naval Ordnance Laboratory, White Oak, Md., discussed the "Transition from Research to Production," a subject which is attracting more and more attention. Bridging this gap is one of the real problems in the services and industry.

In the quality-control field, R. L. Storer, Ordnance Ammunition Command, discussed "Quality Evaluation and Control on Ordnance Ammunition," presenting the customer viewpoint. O. R. Swanson, Stewart-Warner Corporation, presented the industry viewpoint with a paper entitled "Quality Control."

Mines Committee Holds Meeting at Army-Navy Club, Washington

J. McWilliams Stone, Chairman of the Mines Committee of the newly formed Underwater Ordnance Division, held a meeting of his Committee at the Army-Navy Club, Washington, D. C., on January 6, 1955. Present at the meeting were Col. H. N. Marsh, general chairman of Technical Divisions and Committees; Capt. C. B. Stevens, U.S.N.; Comdr. E. B. Jarman; and M. C. Hansen, Navy Bureau of Ordnance, advisory members, and staff consultants from national headquarters, A.O.A.

Methods of procedure for the Committee were discussed, and it was agreed that the Bureau of Ordnance would present problems directly to the chairman of the Mines Committee for Committee study and report.



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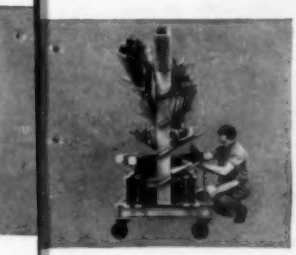
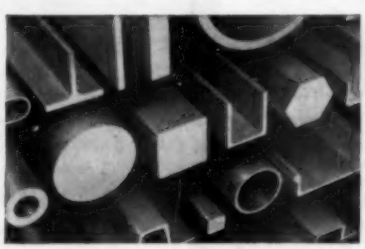


Inspector checking special extruded shapes offered in a wide variety of alloys and sizes.



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Nonferrous Metallurgy Committee Visits Pitman-Dunn Laboratories

Chairman L. A. Ward of the Nonferrous Metallurgy Committee, Advisory Technical and Research Group, held a meeting at the Pitman-Dunn Laboratories, Frankford Arsenal, Philadelphia, on January 7, 1955, with about forty members and guests present. The meeting was held for the particular purpose of discussing welded overlay rotating bands and witnessing demonstrations of the process at the Pitman-Dunn Laboratories.

Brig. Gen. Joseph M. Colby, commanding general, Frankford Arsenal, welcomed the Committee to the arsenal, and extended a very cordial invitation for other A.O.A. Committees and Divisions to hold meetings there. He stressed the Ordnance-Industry Team concept and the need for full utilization of the facilities of the Ordnance Corps in attacking all problems within their individual fields of operation.

M. A. Sheppa, Navy Bureau of Ordnance, discussed very informally and briefly the requirements of the Navy in this field of welded overlay rotating bands.

Frank W. Hussey, Metal Joining Division, Metallurgy Laboratory, Pitman-Dunn Laboratories, gave a full account of the development of these bands.

Irving G. Betz, also of the Metal Joining Division, read a paper on "Notes on Ballistic Evaluation and the Current Research and Development Program" as related to the subject.

Dr. John M. Parks, Air Reduction Company Research Laboratories, representing Dr. A. Muller, chairman of the A.O.A. Welding Committee, commented from the Welding Committee point of view on the subject.

After luncheon served by the Post restaurant in the conference room, the Committee visited the Pitman-Dunn Laboratories and witnessed several different overlay-band procedures.

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LOUIS POLK PRESIDES AT DIMENSIONAL STANDARDS AND METROLOGY MEETING

Louis Polk, A.O.A. vice-president in charge of Technical Divisions and Committees and chairman of the Dimensional Standards and Metrology Division, presided at the tenth meeting of this Division held at the New York Naval Shipyard, Brooklyn, N. Y., on January 12, 1955, with 150 members and guests in attendance.

Chairman Polk opened the meeting, discussing briefly the history of the Division and the work it had accomplished, and introduced Capt. George de Metropolis, U.S.N., administrative officer of the shipyard, who welcomed the Division and explained something of the work it was doing.

Melvin L. Fruechtenicht, manager of the Gage Department, Frankford Arsenal, read a technical paper entitled "The Development, Standardization, and Production Requirements for Ordnance Gaging."

Lieut. Col. Elmer F. Smith, Materials and Industrial Manpower Division, Office of the Director of Industrial Resources, U.S.A.F., presented a paper on "Gaging Problems in the Aircraft Industry."

Dr. Irvine C. Gardner, Chief of the

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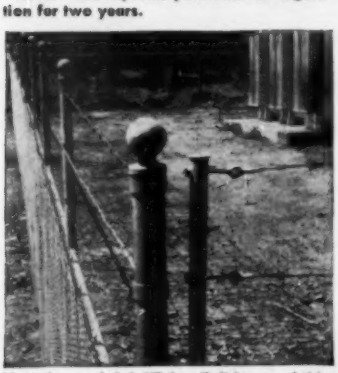

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Association Affairs

Divisions and Committees

Optics and Metrology Division, National Bureau of Standards, gave a most interesting talk on "One Ten-Millionth of an Inch," illustrating his remarks with slides.

Lieut. Comdr. William Dubyk, U. S. Naval Inspector of Ordnance, Pomona, Calif., gave a paper on "Gaging Guided Missiles."

After lunch at the officers' mess, Dean S. C. Hollister, College of Engineering, Cornell University, gave a short talk on "Metrology in Education."

A tour of the yard visiting the U.S.S. SARATOGA, a supercarrier under construction; the U.S.S. BENNINGTON, an Essex-class carrier under repair; and the shops completed a most instructive meeting.

In accordance with A.O.A. policy, the papers presented at this Division meeting will be published in brochure form and will be distributed to all who attended the meeting. Copies will be sent from A.O.A. headquarters upon request.

The brochure prepared from the papers given at last year's meeting of this Division has been distributed as the first of a series to be issued on the annual meeting of each A.O.A. Division.

Certain Committee meeting papers, which are unclassified, will be published from time to time for the benefit of all members of Divisions and Committees.

Guided Missile Committee Chairmen Discuss Organization and Policies

C. L. Eksergian and Weber deVore, chairman and deputy chairman, respectively, of the Guided Missile, Rocket and Jato Division, held a meeting of the chairmen and deputy chairmen of the three Guided Missile Committees extant on January 18, 1955, in the conference room of the Chief of Army Ordnance in the Pentagon with twenty-five members and guests present.

These Committees and their chairmen and deputy chairmen are the:

Guided Missiles Aërodynamics and Structures Committee.—Elmer P. Wheaton, Douglas Aircraft, chairman; Roy J. Sandstrom, Bell Aircraft, and George J. Huebner, Jr., Chrysler, deputy chairmen;

Guided Missiles Guidance and Control Committee.—Daniel E. Noble, Motorola, chairman; S. C. Donnelly, Western Electric, deputy chairman;

Guided Missiles Propulsion Committee.—Dr. R. W. Porter, General Electric, chairman; Charles M. Guy, North American Aviation; Kenneth Campbell, Wright Aëronautical; A. F. Giacco, Hercules Powder, deputy chairmen.

The purpose of the meeting was to discuss the Division-Committee organization; aims, procedures, and policies; membership of Committees; tasks to be undertaken; procedures to be followed; and such other matters as were of common interest.

General Chairman H. N. Marsh warned that A.O.A. Divisions and Committees were "service" organizations and should concern themselves strictly with technical problems that are given them by the armed services and should avoid any matters relating to pricing or contracting. The latter are not within the purview of A.O.A. Technical Division and Committee operations.

Several problems were submitted by the Army, Air Force, and Navy representatives present which the Committees will act upon.

The chairman announced a similar meeting to be held on March 15th in the Pentagon.

The first meetings of the full Committees are scheduled for some time later in the spring, probably at Patrick Air Force Base, Cocoa, Fla.

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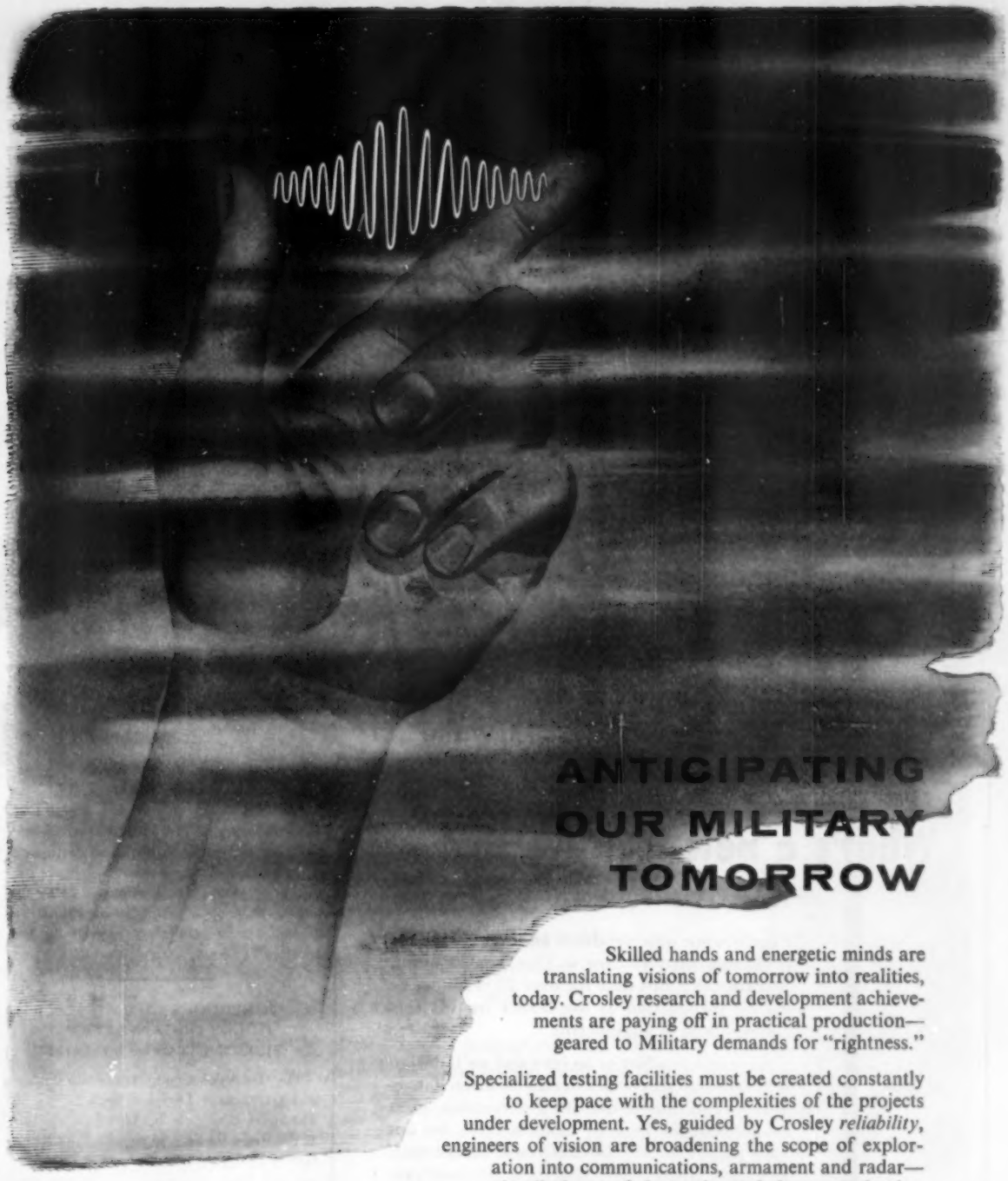
DEVELOPMENT AND MATERIAL COMMITTEE MEETS AT THE ARMOUR RESEARCH INSTITUTE

The Development and Material Committee, of the Guided Missile, Rocket and Jato Division, under the chairmanship of Howard L. Miller, held a special classified meeting on January 13, 1955, at the Armour Research Institute to discuss the methods of lining up production of parts for certain rockets.

J. Pinsky, of the Armour Research Institute Staff, outlined the projectural setup with regard to the development of design, the production of a prototype by Armour Research Institute, and the procurement of test parts by the Redstone Arsenal. The industry Committee members present discussed the problems raised by the newly required materials and agreed to proceed with the project upon receipt of proper drawings and specifications.

The same Committee also met on January 24th at the Allegany Ballistic Lab-



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oratory, Cumberland, Md., under the able chairmanship of Mr. Miller.

The purpose of the meeting was to consider the present metal specifications for the different rockets, boosters, and guided-missile parts that are under development at the Allegany Ballistic Laboratory. This was a classified meeting with representation from the steel companies, particularly those having seamless tube mills, as well as from the Hercules Powder Company, which operates the laboratory for the Navy Department.

Henry Marsh, general chairman of A.O.A. Divisions and Committees, and Brig. Gen. Burton O. Lewis, staff consultant, were present.

During the course of the day, Committee members were permitted to witness the test firing of one of the larger guided-missile booster units. In the discussion period, it was brought out that a meeting later on in the year at the Redstone Arsenal was desirable, at which time a tabulation of the metal specifications currently in use in the missile and rocket field would be presented for information and discussion.

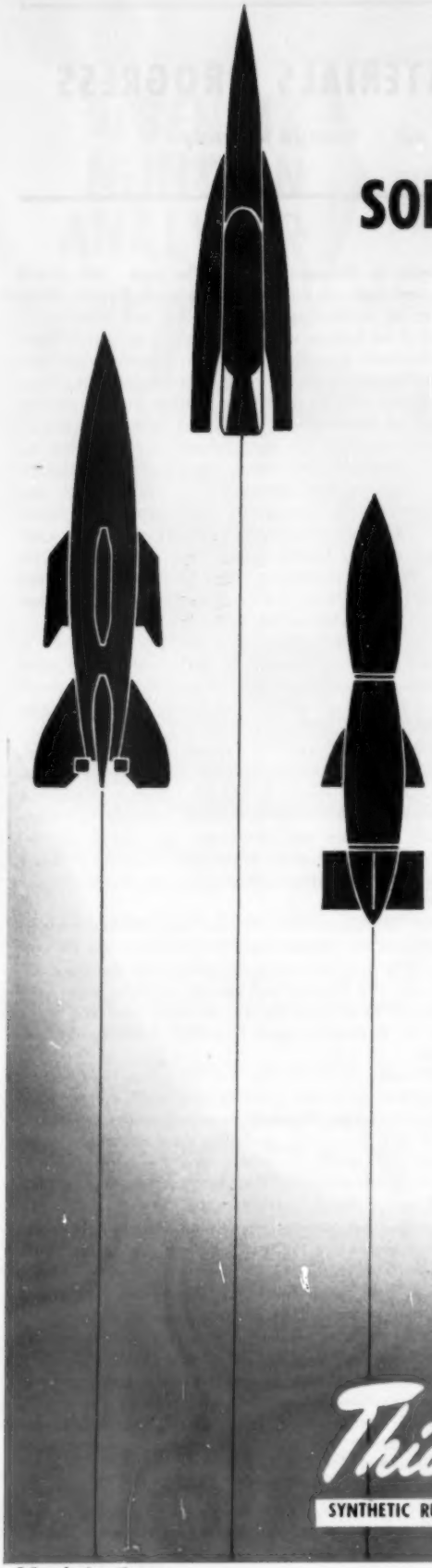
This very active Committee is to be commended for its leadership on the part of Howard Miller. Since his Committee works across the board with all the Committees of the Guided Missile, Rocket, and Jato Division, he receives many problems for Committee consideration. The speed with which he goes into action and the coöperation and enthusiasm of the Committee members, together with the excellent arrangements that are made for meetings, places this Committee away up among those fine Committees which are at the top in rendering "service to the services."

TORPEDOES COMMITTEE HOLDS ORGANIZATION MEETING JANUARY 25TH

The Torpedos Committee of the Underwater Ordnance Division, with Dr. G. R. Tatum as chairman, held its first meeting at the Franklin Street Annex of the Naval Gun Factory, Alexandria, Va., on January 25, 1955. This was a meeting to form the Committee, discuss its membership, and examine the excellent display of torpedoes which had been set up there by the Navy Department.

Due to the location and the subject matter to be discussed, the meeting was classified and attendance was limited to members of the Committee and Navy representatives. Brig. Gen. Burton O. Lewis, staff consultant, also was present.

The purpose of the meeting was fully accomplished and the Committee is off to a good start. It has several difficult problems already received for solution.



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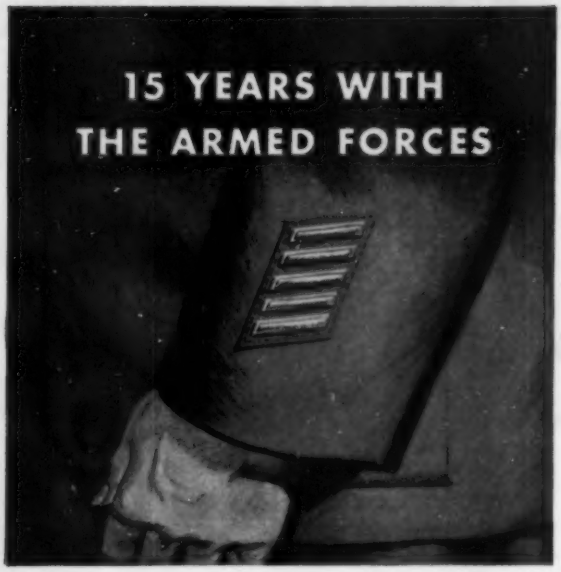

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MATERIALS PROGRESS

George S. Brady

Developments in Strategic Alloys.—The year 1955 should bring some new light on the quantitative needs for the scarce strategic alloying metals, particularly nickel and cobalt.

At the end of the Korean war, when analysts who were figuring the requirements for nickel, cobalt, molybdenum, vanadium, and tungsten for heat-resistant alloys for temperatures from 1,500 to 2,000 degrees Fahrenheit were placing annual full-scale military needs at fabulous figures, turbojet designers were already looking forward to speedier airplanes that would call for construction materials to resist temperatures above 2,200 degrees.

Merely to increase the percentages of nickel, cobalt, and tungsten in the alloys to improve the heat-resistance as needed for the advanced designs would make an almost impossible supply situation. Moreover, it became evident that with demands for even higher speeds these types of alloys would not be adequate to withstand the increased engine temperatures, which now appear to be in ranges above 2,500 degrees.

Steps taken in the past three years have been successful in increasing the productive capacity of nickel, cobalt, and other alloying metals, but more important has been the success attendant on efforts to develop more resistant substitutes for the older types of high alloys.

Intensive development work on cermets (metal oxide compounds) has now reached a point where it can be safely predicted that this entirely new group of materials, while not having sufficiently high tensile and impact strength to replace completely the expensive and hard-to-get high alloys, will decrease greatly the requirements for the high alloys for ordinary heat-resistant uses and also replace these alloys entirely for the newer superheat uses.

Many metal oxides, nitrides, silicides, and carbides are now available commercially that are capable of withstanding the corrosive action of flame temperatures well above 3,500 degrees Fahrenheit, and some, like tantalum and hafnium carbides, above 7,500 degrees. Most of these materials are extremely hard and brittle and are not in themselves good structural materials for mechanical parts.

Efforts to make them practical for jet engine and turbine parts are in three directions: (1) molding and sintering them with a nickel-chromium or cobalt-chromium binder, which the Germans call WZ alloys, (2) combining them in chemical combination with other oxides to give a strong structure, or (3) using them as a metal-ceramic flame-resistant coating on plain carbon steel.

Molded oxides and carbides with metal binders are strong, but the heat resistance is limited to the melting points of the metal binders. However the *Carborundum Company*, Perth Amboy, N. J., now has a silicon carbide bonded with silicon nitride that can be molded to intricate shapes to close tolerances, giving a rupture strength of 5,600 pounds per square inch at a temperature of 2,450 degrees Fahrenheit.

The Air Matériel Command has been active in testing cermets offered by various companies and, while the results are, in general, classified information, it is known that molybdenum silicide-silicon carbide has given good results in rocket nozzle bodies and other parts.

The *Firth-Stirling Steel Company*, through its subsidiary, the *Borolite Corporation*, Perth Amboy, N. J., has also been active in development work on cermets. Its zirconium boride,

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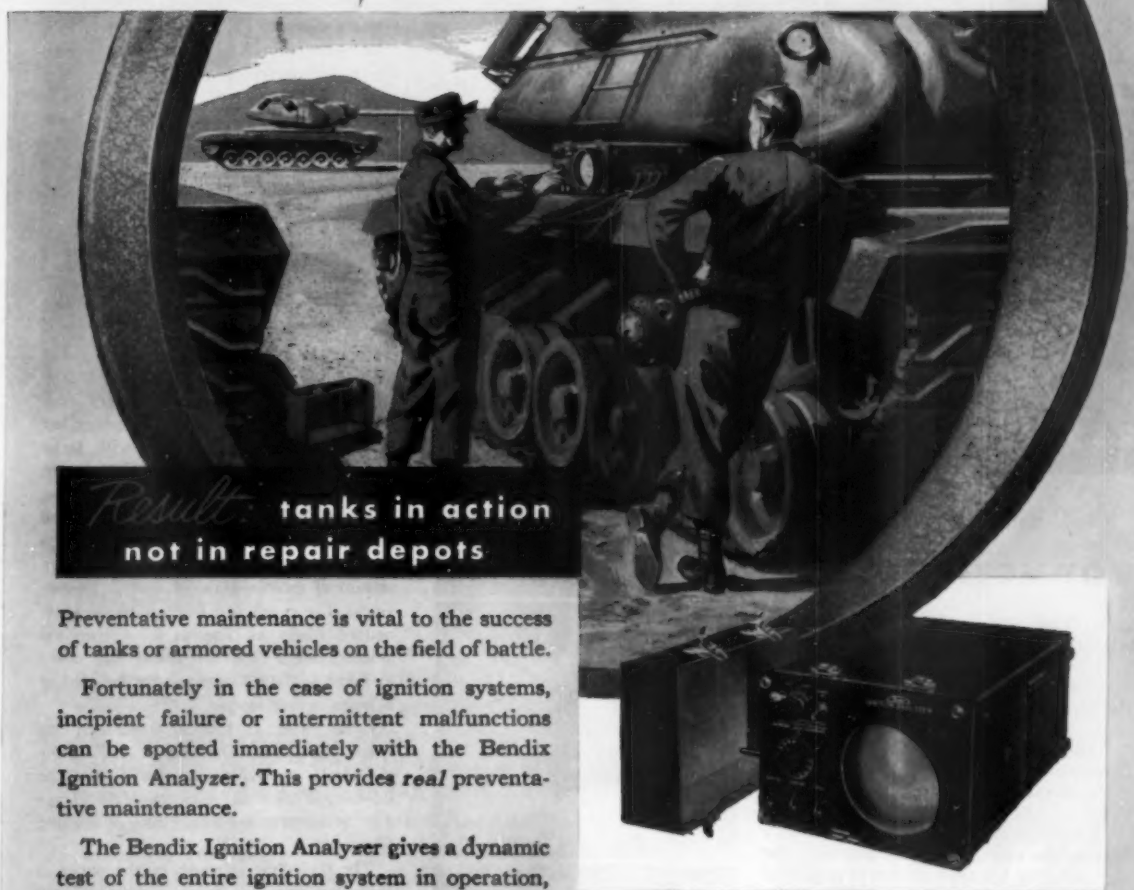
the only way to make a COMPLETE, POSITIVE, DYNAMIC check of the ENTIRE Ignition System . . . without removing the engine



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Fortunately in the case of ignition systems, incipient failure or intermittent malfunctions can be spotted immediately with the Bendix Ignition Analyzer. This provides *real* preventative maintenance.

The Bendix Ignition Analyzer gives a dynamic test of the entire ignition system in operation, outmoding time-consuming static testing of individual components. It is the easiest (checks the entire ignition system in the *field*) and the fastest (locates *any* ignition fault immediately) method of preventative maintenance ever devised for checking ignition efficiency in military vehicles of all types.

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Materials Progress

ZrB_2, withstands heat to about 5,400 degrees Fahrenheit and, when molded and sintered with a small amount of binder, produces parts with a tensile strength up to 40,000 pounds per square inch, which is comparable with many metallic construction materials.

Ceramic Coatings.—*The National Bureau of Standards* has announced results of a systematic study of ceramic coatings compounded with refractory oxides such as chromic oxide, CrO_3, and cerium oxide, CeO_2, which will give good bonds with steels containing chromium and will protect the steels from flame and hot-gas erosion. The coatings do not require a thickness of more than 0.002-inch.

The Bureau has standardized on a basic frit containing about 50 per cent silica, 25 per cent barium oxide, 10 per cent beryllium oxide, and smaller amounts of zirconium oxide, zinc oxide, and phosphorus oxide. Thirty-five per cent or more of the refractory oxides are compounded with this frit to make the coating material. It has been tested successfully for atomic reactors, gas turbine combustion-chamber liners, tail cones, and afterburner liners.

It is also noted that ceramic-coated carbon steel is being used instead of nickel-bearing stainless steel in rocket-launcher tubes and in reciprocating-engine exhaust systems.

Stainless Steel.—Savings in nickel are also anticipated from an extended use of manganese-chromium stainless steels. These steels were first used in Germany to replace nickel-bearing stainless steel, but so much difficulty was experienced in the working of the steels in this country that they were almost withdrawn from the commercial market.

But technical officials in the defense services now say that further development of the alloys has resulted in workable steels of higher strength and higher heat resistance than ordinary 18-8 stainless. They have been employed for turbine buckets and propeller blades for gas-turbine engines.

Glass Paper.—Development work on a new type of glass-fiber paper which tests indicate will have wide application for filtering chemicals and gases and for electrical insulation has been completed by the *Naval Research Laboratory*, Washington, D. C.

Research work on the paper has been going on for nearly five years under the direction of Thomas D. Callinan, with the actual production of the paper at the *National Bureau of Standards* under Martin J. O'Leary of the Bureau staff and Robert T. Lucas of the Naval Research staff. The technique is now being offered to private industry for commercial production.

Early attempts to manufacture paper from glass fiber failed because of the difficulty in preventing coarse fibers from settling out of the water. The answer lay in producing superfine fibers with large surface area in proportion to weight which could be held in colloidal solution.

Owens-Corning Fiberglas Corporation developed a new method of production which consists in blowing hot gases into a stream of molten glass of special composition. The result is a fluffy mass of white matted fibers as fine as 0.5-micron diameter, but it has been found that fibers as large as 1 to 3 microns can be used at a large saving in cost.

Glass paper as thin as 0.002-inch has been produced. The paper will filter chemicals, removing particles as small as 0.3-micron with an efficiency of 99.99 per cent at faster rates than filters of organic fibers.

The dielectric strength of the paper is high, but since the paper is permeable an impregnation is necessary for use as an electrical insulator, and the dielectric strength is thus limited to the dielectric strength of the synthetic resin impregnant. It can be used to replace mica for some applications and has been used successfully for some types of capacitors.

Lightweight Barges.—The first welded aluminum barges built in the United States are now in service at Rockdale, Tex. They are 13.5 feet long, 7.5 feet wide, and 2.5 feet deep. One is made of aluminum alloy A54S, and the other of aluminum alloy XC56S. They carry a greater dead weight than steel barges of the same draft.

RESEARCH
DEVELOPMENT
PRODUCTION
To design and develop such outstanding helicopters as the HTK-1 and the HOK-1, Kaman Aircraft has assembled a complete engineering staff skilled in the fields of mechanical design, electronics, aerodynamics with special emphasis on the development and production of electro-mechanical devices and systems. Moreover, the production of Kaman helicopters requires large plant facilities and an impressive inventory of machine tools and equipment from the smallest electronics part to presses of huge capacity. Each contributes to Kaman Performance, and . . .
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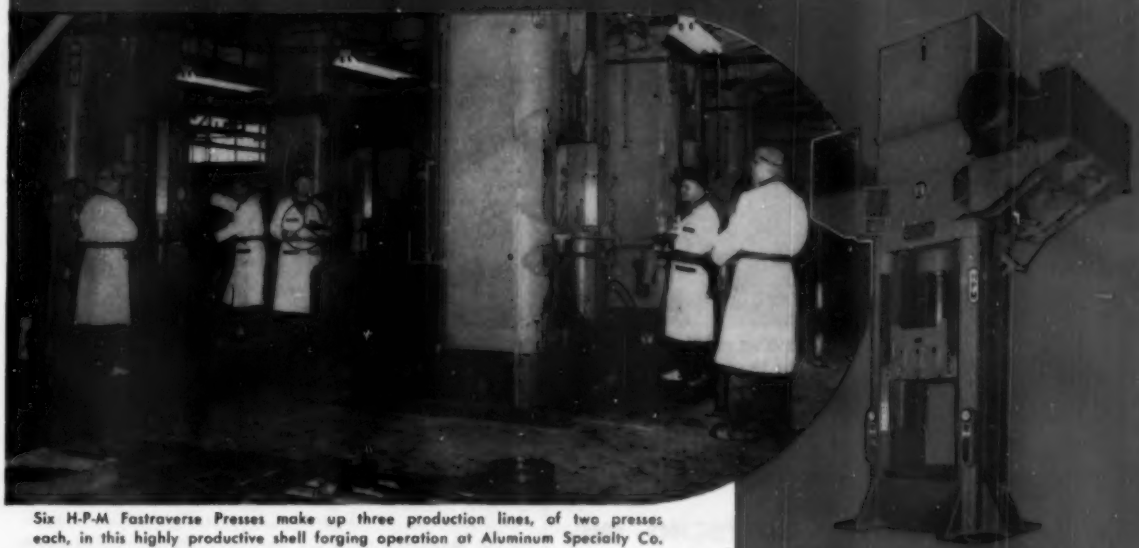

Six H-P-M Fastraverse Presses make up three production lines, of two presses each, in this highly productive shell forging operation at Aluminum Specialty Co.

Mr. R. V. Hansen, Plant Manager, Aluminum Specialty Co., Iron Mountain, Michigan is an enthusiastic H-P-M booster. Read what he has to say about H-P-M presses.

"Thanks to your very efficient presses," wrote Mr. Hansen, "and our competent workers, our hourly forging turnout has gone way above your press rated output and has even surpassed our own expectations. On a comparative basis the quality of our manufactured forgings is far superior to the quality of forgings we had purchased elsewhere. Downtime due to press failure has been negligible. Service-wise, performance-wise and production-wise — we highly recommend a hydraulic press investment in H-P-M."

When users report increased production *above rated output,* quality of work *improved* and maintenance a *negligible factor* — we feel justified in recommending H-P-M presses without qualification. Our experience can be invaluable in your production planning.

When you are bidding on a contract where quality and production output are major requirements, call in an H-P-M engineer at the planning stage. The experience of our specialists is yours for the asking. H-P-M presses have helped to establish production records for major producers of ordnance through three national emergencies.

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Materials Progress

Aluminum-Alloy Chains.—Anchor chains made by the *Baldt Anchor Chain & Forge Division, Boston Metals Company*, Chester, Pa., for the Canadian Royal Navy minesweepers are of aluminum alloy 7075. The links were forged in two mating sections and, after assembly, were heat-treated to the T-6 temper. Tensile tests showed a strength exceeding 77,000 pounds per square inch.

New Bus Bars.—*Reynolds Metals Company*, Louisville, Ky., is featuring the savings in cost, labor, and maintenance by the use of aluminum bus conductors instead of copper. The aluminum has a tensile strength of 29,000 pounds per square inch, and a current-carrying capacity 79 per cent that of copper.

But, for a current load of 700 amperes, a copper bar weighing 2 pounds per foot is required, while the same current can be carried with an aluminum bar weighing only 0.8 pound per foot, thus saving 60 per cent in weight. The light weight results in easier handling and lower installation costs.

Improved As-cast Finish.—By improvement in casting techniques, *Aluminum Company of America* has now achieved a finer finish on aluminum die castings for automotive and builders' hardware and for appliance parts. The new as-cast finish can be chromium plated easily, improves the colored Alumilite finishes, and buffs readily to a fine natural finish.

Magnesium Hangar.—A lightweight portable aircraft hangar built by *Magnesium Products*, Milwaukee, Wis., for the Navy is made entirely of magnesium and can be erected without the use of cranes. It is 50 feet long, 80 feet wide, and 33 feet high, with a total weight of only 15,000 pounds.

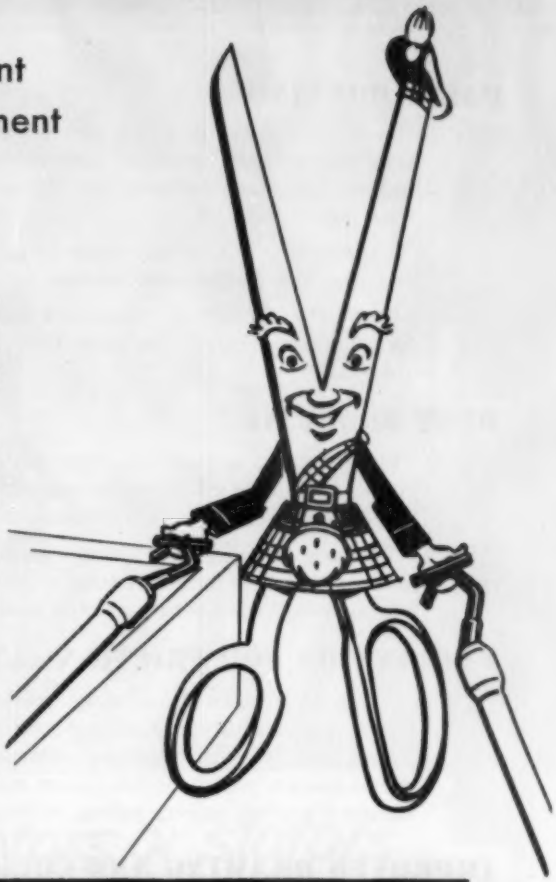
The assemblies are prefabricated, and the joints are pinned in place. The side bents are easily tipped into position. The roof trusses are assembled on the ground, and the entire roof is raised into position with ten built-in winches. All parts of the structure can be broken down quickly for shipment.

Plastic Barge.—A new Army cargo barge, 51 feet long, that can transport 5 tons of cargo with a draft of only 2 feet or can carry a full load of 10 tons, is built of plastic in a sandwich construction and is made in 15 sections for ease of transport. It is powered by two 165-horsepower Diesel engines.

The construction consists of a central core of honeycombed cotton duck impregnated with phenolic resin. The outer layers are of woven polyester-impregnated glass fiber bonded to the duck core with an epoxy resin.

New-type anodes reduced plating costs

"Mr. Cost Cutter" shows how plant offset expense of the new equipment with actual dollar-savings



AT ONE plant, ordinary flat lead anodes used in chromium plating needed costly weekly maintenance to remove insulating deposits which built up on their backs. Two men worked a full day each week at overtime—lifting out anodes, brushing them clean, and correcting warpage from overheating.

An original development by United Chromium—*cylindrical* anodes—was brought to this plant's attention by The Unichrome Man. First order for anodes came to $1560.

What a difference the Unichrome Round Anodes made!

Weekly maintenance stopped. The round shape gave better current distribution which ended the need for cleaning. Its rigidity stopped the warping. The payoff: Unichrome Anodes have saved as much as their original cost in reduced maintenance. In addition, they are delivering better plating with lower current and voltage—thereby enabling a standby $29,000 generator to be transferred to other work in the plant!

Here you have another example of how putting United Chromium's long metal finishing experience to work means savings on equipment. May we put it to work for *you*?

MORE WAYS UNITED CHROMIUM HELPS TO SAVE ON COATING OF METALS

More durable protection

Only Unichrome Coating 218X is now used to insulate zinc plating barrels in one automotive accessory plant... because it proved to be the most durable of all plastisol coatings tested for this job, and therefore the most economical.

Plans to production—faster

When one company recently decided to chromium plate diesel engine crankshafts, they called in United Chromium to plan and supply materials and equipment for the operation. Result: The plant is pleased with the speed with which they got a smoothly running efficient set-up.

Chromium plating economies

Recent reports show: Unichrome SRHS Chromium Solution cut power costs 60% for one user. . . . It saved about $3000 a year for another plant by cutting daily bath additions from former 500 pounds down to 300. . . . It gave a shop 66% more capacity with existing equipment.

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"GRANODINE"® forms a zinc-iron phosphate-coating bond on sheet metal products—automobile bodies and fenders, refrigerator cabinets, etc.—for a durable, lustrous paint finish.

"LITHOFORM"® makes paint stick to galvanized iron and other zinc and cadmium surfaces.

"ALODINE"®, the new ACP protective coating chemical for aluminum, anchors the paint finish and protects the metal.

RUST PROOFING

"PERMADINE"®, a zinc phosphate coating chemical, forms on steel an oil-adsorptive coating which bonds rust-inhibiting oils such as "Granoleum"

"THERMOIL-GRANODINE"®, a manganese-iron phosphate coating chemical, forms on steel a dense crystalline coating which, when oiled or painted, inhibits corrosion.

PROTECTION FOR FRICTION SURFACES

The oiled "THERMOIL-GRANODINE" coating on pistons, piston rings, cranks, camshafts and other rubbing parts, allows safe break-in operation, eliminates metal-to-metal contact, maintains lubrication and reduces the danger of scuffing, scoring, galling, welding and tearing.

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"GRANODRAW"® forms on pickled surfaces a tightly-bound adherent, zinc-iron phosphate coating which facilitates cold forming and extrusion, improves drawing and lengthens die life.

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"DEOXIDINE"®, the pioneer of the phosphoric acid-solvent type metal cleaners, removes rust and grease, destroys rust stimulators, and creates an etched inert surface that bonds paint firmly. "DEOXIDINE" prepares steel, aluminum, brass, copper and other metals properly for painting.

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Materials Progress

The outer skin is 3/16-inch thick, the inner skin is ⅛-inch, and the core is 1 inch thick. This construction gives rigidity equal to a ⅜-inch steel plate with only a fraction of the weight.

Plastic Airplane.—A new Taylorcraft light commercial airplane is molded of glass-fiber-reënforced polyester plastic formed by hand layup in plaster molds. Since it is as easy to mold curved surfaces as straight sections, designs could be altered to provide greater shoulder space in the fuselage and to fit the gas tank to irregular spaces to give greater fuel capacity. The fuselage is molded in two sections and fastened to the longerons by bolts and straps.

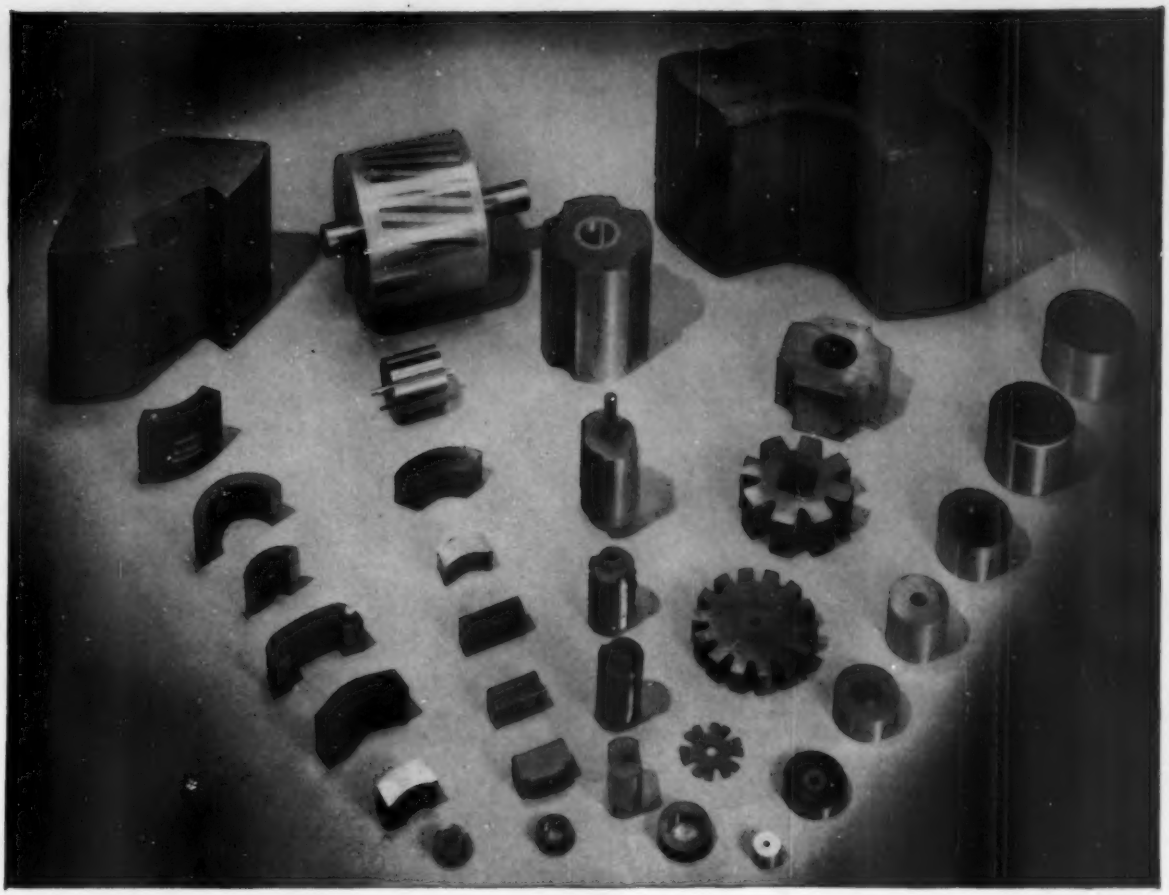
The wing skin is fastened to the spars and ribs with blind rivets. The plastic skin gives an increase in speed of 12 miles an hour. Higher cost of the plastic is more than offset by lower labor cost in construction. Other advantages claimed are better weathering and corrosion resistance, easier repair, and lower maintenance costs.

Tin-Zinc Plating.—A method of tin-zinc plating developed by the *Tin Research Institute* (London) has been approved by the British Ministry of Supply for the protection of hydraulic brake parts and other steel aircraft parts produced on government contracts. The alloy used contains 75 per cent tin and 25 per cent zinc. It gives a white, adherent coating that is very corrosion resistant. Tin-zinc plating is used in the United States on electrical and appliance parts especially where good soldering ability is needed.

Foam Insulation.—Ready-mixed powders for making built-in-place foam insulation or foamed-in-place sandwich structures are now being offered by the *Dow Corning Corporation*, Midland, Mich. The powder consists of silicone resin, a filler, a blowing agent, and a catalyst. When heated, the mixture melts, foams, and cures compactly into the space. The density can be controlled between 8 and 18 pounds per cubic foot by varying the temperature. The closed cells formed in the foam are uniformly distributed.

Plastic Pipe.—A new lightweight plastic pipe with exceptional heat resistance and resistance to chemicals, being marketed under the name of Fluoroflex-T by the *Resistoflex Corporation*, Belleville, N. J., is made of glass fabric laminated fluorocarbon resin. It will stand working pressures to 50 pounds at temperatures to 500 degrees Fahrenheit. The pipe comes in 1-, 1½-, and 2-inch diameters in 12-foot lengths.

Silicon Rectifiers.—A silicon rectifier, originally developed under a Signal Corps



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industrial-preparedness contract, is now being offered on the commercial markets by *Transitron Electronic Corporation*, Melrose, Mass. It is only a small fraction of the size of a comparable selenium rectifier and has the added advantage over selenium that it will operate at 98 per cent efficiency over a range from minus 65 to plus 150 degrees Centigrade.

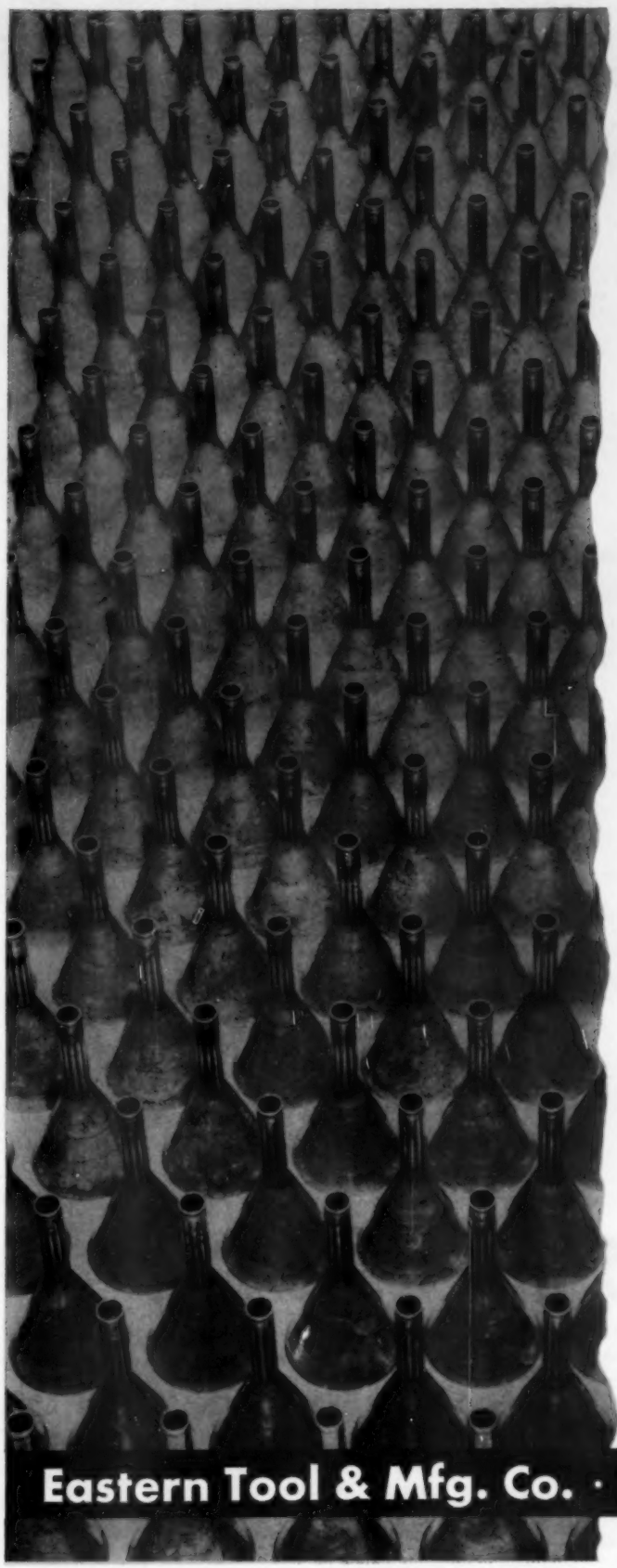
Westinghouse Electric Corporation also has a silicon rectifier for which the company is equipping commercial production facilities. Selenium is a scarce strategic material that has been in chronic short supply, and silicon appears to be one of the most likely materials to replace it as a semiconductor. But the difficulty has been the excessive cost of producing and melting the pure metal. Westinghouse engineers believe that they have now conquered this problem.

Plating Magnesium.—The increasing use of the light metal magnesium for a wide variety of mechanical and electrical parts, especially for appliance housings, has accented the need for a method of electroplating that will produce an adherent bond to the metal. *Dow Chemical Company*, Midland, Mich., has issued a booklet (printed in England) that gives detailed instructions for such plating.

To plate magnesium, a thin coating of zinc is first applied by chemical reduction from a water solution of zinc sulphate and sodium pyrophosphate. The pyrophosphate frees the oxide from the surface of the magnesium, and a zinc film about 0.0001-inch thick is formed uniformly over the surface. An electrodeposit of copper is then made from a cyanide bath, the copper having a minimum thickness of 0.0003-inch. Almost any other metal can then be electroplated in a conventional manner over the copper.

Nylon for Bearings.—Nylon-lined sleeve bearings that will operate either with or without lubricant are being produced by the *Nylacore Corporation*, Great Neck, N. Y., in any size, starting with the smallest which measures 0.030-inch inside diameter, 0.080-inch outside diameter, and 0.040-inch long. The nylon lining on the metal is 0.005-inch thick, and it alternates with depressed spiral grooves to carry lubricant.

Aluminum Signs.—About 2,440 highway signs on the new 241-mile Ohio turnpike are made of aluminum sheet and aluminum extruded panels furnished by the *Aluminum Company of America*, Pittsburgh, Pa. Some of the signs are as large as 10 by 21 feet. Posts, extruded clips, and bolts are also of aluminum. The metal was selected because of its corrosion resistance, low maintenance cost, and ease of repair.



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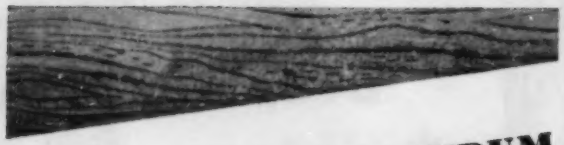

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To: Ordnance Engineering Officers

From: Gear Specialists

Subject: Solution to Gearing Problems

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RECENT PATENTS

This department on recent military-industrial patents is being published in ORDNANCE *to keep our readers informed of the latest developments in these fields. The data are compiled by Melvin Nord, patent attorney, Detroit, Mich. Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D.C., at 25 cents each.*—THE EDITORS.

MANUFACTURE OF SMOKELESS POWDER

• *U. S. Patent No. 2,691,192. Issued October 12, 1954. Leavitt N. Bent. Assigned to Secretary of the Army.*—Smokeless powder grains are prepared in small diameters by extrusion of a colloidal powder mass suspended in a volatile solvent. Larger diameter strands, known as stick-type powder, are colloided without the use of volatile solvents, since it would be difficult to remove the solvent. This extrusion operation is hazardous because relatively large amounts of powder are confined under extreme conditions of temperature and pressure.

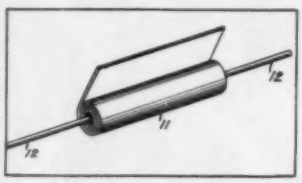


Fig. 1. Rolling powder.

The present invention provides a method of preparing sticks of smokeless powder of both large and small diameter without a solvent. The method involves preparing billets of smokeless powder by rolling sheets in the form of carpet rolls (see Fig. 1, in which a roll 11 is shown on a mandrel 12), heating the billets to about 70 degrees Centigrade, and then rolling the billets through a series of grooved rolls. This reduces the diameter and elongates the billets, forming sticks which compare favorably with those produced by extrusion techniques.

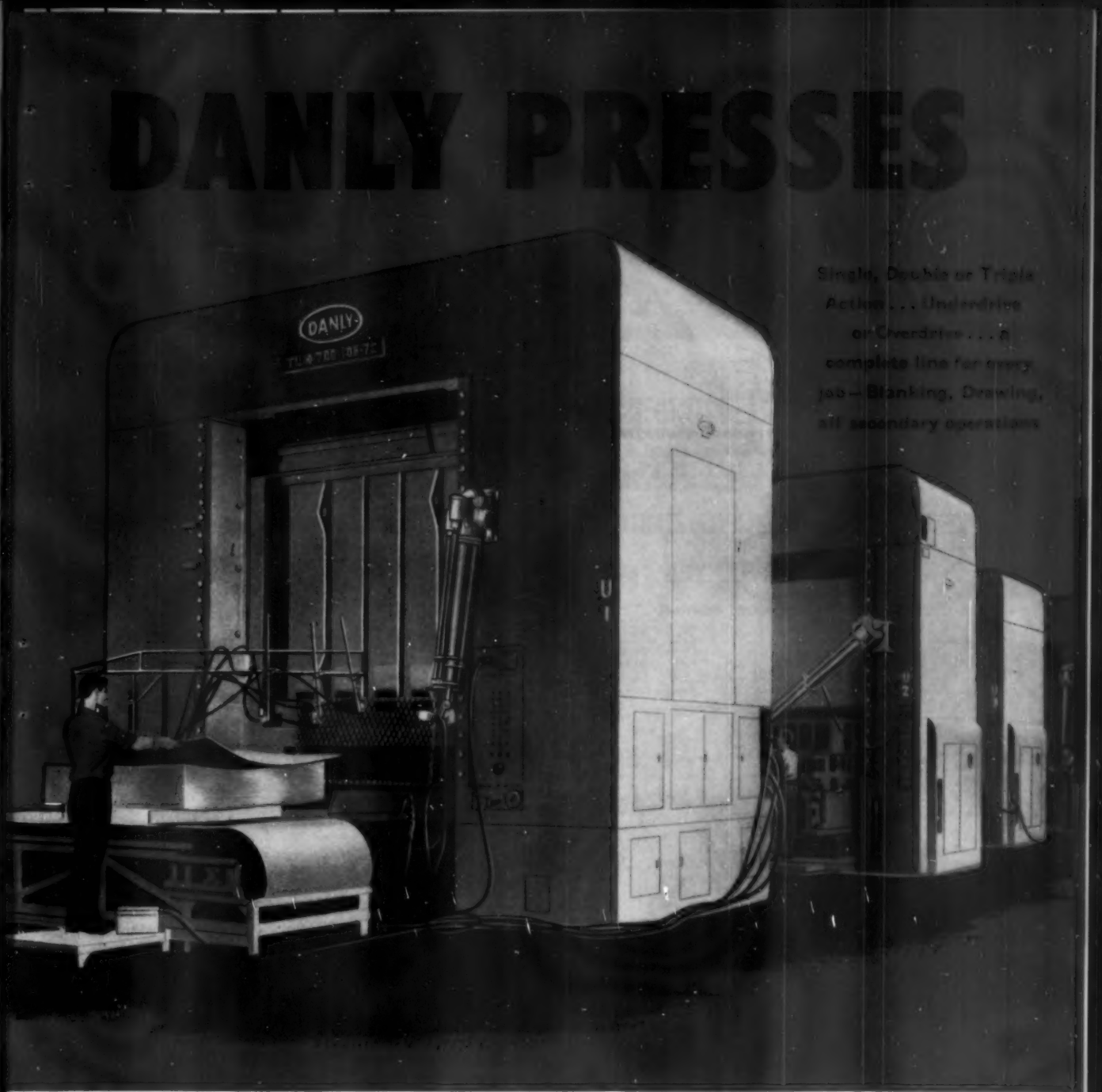
METHOD OF RECOVERING EXPLOSIVES

• *U. S. Patent No. 2,691,800. Issued October 19, 1954. Fredrick R. Seavey, assigned to Olin Industries, Inc., East Alton, Ill.*— In the breaking down or disassembly of loaded ammunition it is common practice to segregate explosives, such as trinitrotoluene and cast compositions containing trinitrotoluene as the binding agent, by melting the explosive and removing it from shells, bomb heads, and other containers. This is a hazardous operation, is expensive, and generally gives poor results.

In the present patent the explosive is recovered in particulate form in a simple, nonhazardous manner. The explosive is placed in a water bath which contains a protective colloid at a temperature above the melting point of the explosive. The bath is agitated until the explosive is of the desired granulation and is then cooled to a temperature below the freezing point of the explosive. The agitation tends to break up or subdivide the molten explosive.

The colloid not only prevents the explosive particles from sticking together and adhering to the walls of the vessel but also prevents segregation of the ingredients of the explosive. The colloid may be gum arabic, dextrin, starch, or a colloid derived from animal protein.

DANLY PRESSES



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FLAT-ROLLED FINISHING EQUIPMENT

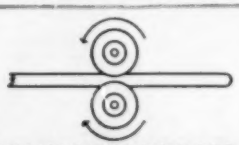
This is one of Aetna's six major product lines. Flat-rolled embraces such equipment as: Shearing and Classifying; Scrubbing and Drying; Recoiling; Slitting and Side Trimming; Roller Levellers (two-high and four-high); Reels of all kinds; and many other products.

CONTINUOUS COATING

This year Aetna will have completed the building of 25 continuous galvanizing lines, in addition to several terne and electrolytic tinning lines. Aetna has worked closely with industry in this development and is considered the pioneer in continuous coating equipment.

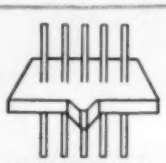
ROLLS

Aetna specializes in manufacture of small and medium-sized iron-base rolls. Aetna is pioneering in the use of Nodular Iron for rolls and castings under trade name of Magaloy.



CONTINUOUS BUTT WELD PIPE MILLS

Over the years, new ideas and engineering accomplishments have strengthened Aetna's position as the only builder in America of Continuous Butt Weld Pipe Mills. In recent months, Aetna Pipe Mill equipment has been installed in America, in Canada, in Germany, in England, in Japan and in Argentina.



COLD DRAWING

The world over, Aetna-Standard is recognized as the leading authority and builder of cold draw equipment for tubes and bars. This year marked introduction of several innovations by Aetna, such as the air gripper carriage and hook.

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GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS

Recent Patents

PRESSURE VALVE FOR ROCKETS

• *U. S. Patent No. 2,690,669. Issued October 5, 1954. Leo V. Giladett, Silver Spring, Md.*—This invention describes a valve which responds to a successive increase and decrease of pressure, such as would be found in the rocket fuel chamber prior to and at burnout. The valve establishes, at burnout, communication between the rocket chamber and a telemeter, the latter being a high-accuracy pressure-sensing device that telemeters its sensings to a ground receiver.

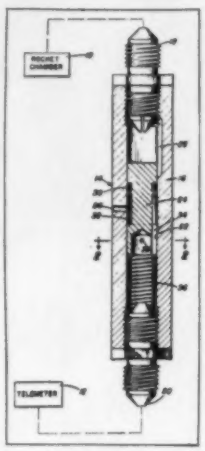


Fig. 2. Rocket valve.

The apparatus is shown in Fig. 2. Assuming that the rocket is at rest, the valve element 24 is moved, compressing spring 36 until shear wire 38 can be fitted in its passage in the valve body 16 and element 24. The wire is strong enough to hold the spring in the compressed condition. Then the rocket is fired, rocket chamber pressure being applied through coupling 18 to element 24, moving the latter slightly in valve chamber 22 to compress spring 36 completely.

The force derived from rocket-chamber pressure is great enough to shear wire 38. During this time, port 26, which is exposed to ambient pressure, is open to the telemeter through channel 32, groove 34, and a part of valve chamber 22. When the rocket-chamber pressure decreases, as at rocket burnout, spring 36 moves valve element 24 in valve chamber 22, closing atmosphere port 26, and communicating telemeter 12 with the rocket chamber 10 through passageway 28 which opens into groove 32.

CONCENTRATION OF HEAVY WATER

• *U. S. Patent No. 2,695,268. Issued November 23, 1954, to Charles A. Holstead. Assigned to the U. S. Atomic Energy Commission.*—This patent describes an improvement in the method of concentrating heavy water by electrolysis. In this process, hydrogen and oxygen are liberated by electrolysis, leaving a liquid in the cell which is enriched in heavy water. A number of such electrolytic steps are used. The gases from a given cell are combined by combustion to form water somewhat depleted in heavy water, and this is returned to an appropriate point in the system.

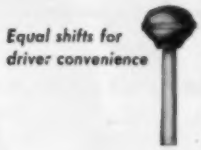
The present invention provides a means of preventing carry-over of liquid spray with the evolved gases, thereby improving the separating efficiency of any given stage of the process. This is accomplished by causing the gases to pass through a vessel charged with small lumps of caustic potash or caustic soda, depending on which is used in the cell electrolyte. The caustic solution thus formed is fed to cells of approximately the same isotopic concentration.

PURIFICATION OF MUSTARD GAS

• *U. S. Patent No. 2,691,626. Issued October 12, 1954. Charles C. Price, Orville H. Bullitt, Jr., Herbert E. Hudson, Jr., and Arthur M. Buswell. Assigned to the Secretary of the Army.*—Mustard gas prepared by the Levinstein process has the serious objection of being unstable, especially on prolonged storage in steel containers and at elevated temperatures. This instability is apparently due to the presence of certain impurities. The present invention provides a method of purifying and stabilizing Levinstein mustard. The mustard is first washed a number of times with water. After withdrawing the wash water, the washed product is subjected to distillation under reduced pressure. The distillation is stopped when the distillate begins to show evidence of the presence of color-forming bodies.

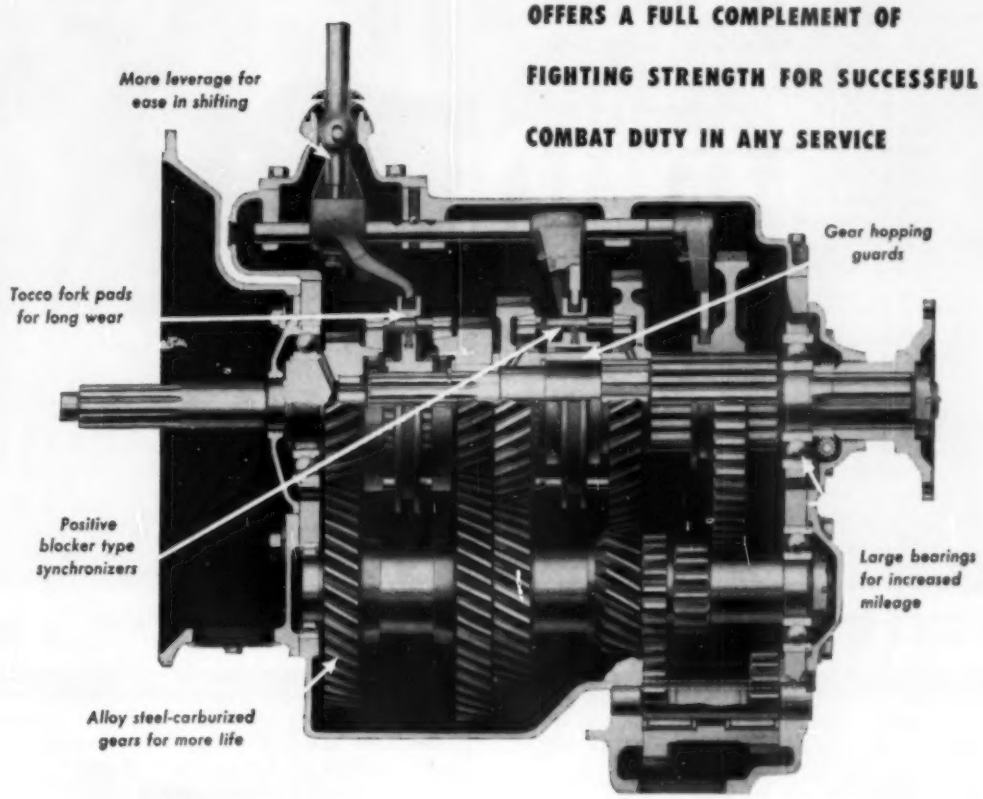
Spicer

SPECIALISTS IN SERVICE



The Spicer Brown-Lipe Fully-Synchronized Transmission

OFFERS A FULL COMPLEMENT OF FIGHTING STRENGTH FOR SUCCESSFUL COMBAT DUTY IN ANY SERVICE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Gear hopping guards
Tocco fork pads for long wear
Positive blocker type synchronizers
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GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION — PARKER PRODUCTS

JAN-C-490 (Replaces AXS-1245 and may be superseded by MIL-C-490A)
- Grade I.....Bonderite 100, 160, 170, 180
- Grade II
  - Type 2.....Parco Cleaners 341, 350, 371
  - Type 4.....Parco Cleaners 250, 260
  - Type 5.....Parco Cleaners 210, 220
  - Type 6.....Parco Cleaners 100, 101, 110

MIL-10578A (Formerly U.S.A. 3-213)
- Type I (Wash-off).....Parco Cleaner 250
- Type II (Wipe-off).....Parco Cleaner 260

MIL-C-5541 (Formerly AN-C-170).....Bonderite 700, 710, 720 (chemical film for aluminum and its alloys)

MIL-C-12968 (ORD) (Supersedes in part U.S.A. 57-0-2)
- Type A—(Formerly U.S.A. 57-0-2, Type 1, Class A & A1)...Parco Powder, Parco Lubrite 1 & 2
- Type B
  - Class 1 (Formerly U. S. A. 57-0-2, Type II, Class B.....Parco Compound
  - Class 2.....Parco Compound plus Endurion

MIL-C-16232A (BuORD)
- Type I.....Parco Lubrite 1 & 2
- Type II.....Parco Compound

PA-PD-191
- Grade I..Bonderite 32, 34, 100, 160, 170, 180
- Grade II
  - Type 2.....Parco Cleaners 341, 350, 371
  - Type 4.....Parco Cleaners 250, 260
  - Type 5.....Parco Cleaners 210, 220
  - Type 6.....Parco Cleaners 100, 101, 110

U.S.A. 72-53.....Bonderite 32, 34, 100, 160, 170, 180

U.S.A. 57-0-2 [See also MIL-C-12968 (ORD)]
- Type II
  - Class A & A1.....Parco Lubrite 1 & 2
  - Class B.....Parco Powder—Parco Compound
  - Class C.....Bonderite 100, 160, 170, 180

For information regarding these or other specifications, write

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RUST PROOF COMPANY

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FIRST IN THE FIELD SINCE 1915

NEW DEVELOPMENTS

COUNTERMORTAR RADAR

Radar is now being used by the Army to detect and track down the source of enemy mortar fire. The new aid is a versatile and mobile radar "eye" which acts as a sentry, warns of enemy movements, and pinpoints enemy mortar locations for destruction.

Far advanced from the experimental stage, American ground forces in several theaters already are equipped with these detector systems, known as countermortar radar AN/MPQ-10. The device was jointly developed and designed by the U. S. Army Signal Corps and the Sperry Gyroscope Company. Early production systems were flown direct from the factory in time for battle testing in Korea.

The new mortar-detection system can be moved rapidly.

With the help of this electronic locator, frontline forces can detect and "lock on" the path of enemy mortar shells, automatically track their trajectory, and obtain computer range data which reveals the enemy position. Counterbattery fire can then be placed on the hostile weapons.

ONE-MAN HELICOPTER

Two helicopter manufacturers have been awarded contracts as a result of a Navy design competition for a rotorcycle (one-man portable helicopter). Gyrodyne Company of America, Inc., St. James, Long Island, N. Y., and Hiller Helicopters, Palo Alto, Calif., submitted the selected designs. Research and development contracts amounting to approximately $200,000 have been placed with each company.

Marines will use this type helicopter for observation, liaison, escape and evasion, and small-unit tactical maneuvers. Both designs selected by the Navy are for a machine which can be collapsed into a small package for easy transportation and quickly assembled.

PORTABLE X-RAY

X-rays of wounded soldiers can be made on the battlefield with a newly designed portable X-ray unit now being subjected to further tests. The new device, powered by radioactive thulium, is capable of producing an X-ray picture without electricity, water, or a darkroom. The complete unit, which also includes a film holder, weighs only forty-eight pounds and may be carried on the back of a medical-aid man. Operation of the machine is so simple that most personnel can be trained to use it in a few

RELIABILITY

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GOVERNMENT PRODUCTS DIVISION

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Rheem's integrated Government Products Division facilities . . . now with strategically located headquarters on both East and West Coasts . . . are presently in quality production on air frames, missile and jet-engine components, airborne ordnance, electronics and ordnance materiel.

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Our steel mill produces ball and roller bearing quality, key stock, cold heading quality spring steel whose surface tolerance, physical specifications and machineability must meet specific requirements. Let us help cut your production costs with fine quality steel.

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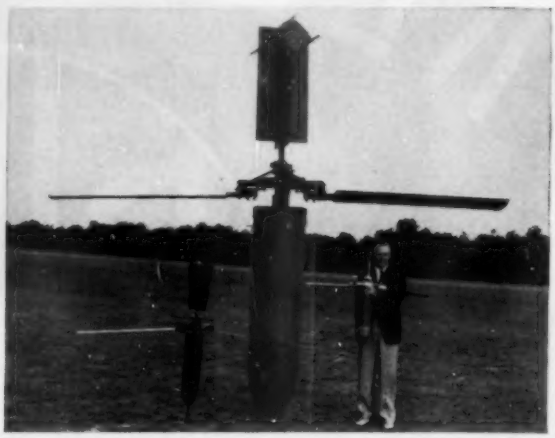
New Developments

hours. The X-ray unit can be set up and a picture taken and developed for reading within five to ten minutes. Timing of the exposure is done with a wrist watch.

THE ROTOCHUTE

The Office of Naval Research and the Kaman Aircraft Corporation of Bloomfield, Conn., recently revealed a new device, being developed for the United States Marine Corps, for supplying beachheads and other confined combat areas from the air. The device, known as a "Rotochute," will permit supply aircraft



The standard M2 air-drop container shown in the center with full-scale Rotochute attached towers over smaller models.

to drop equipment and supplies from lower altitudes at higher speeds and with greater accuracy than is possible with a parachute.

The Rotochute consists of two rotor blades attached to a hub, the entire assembly resembling the rotor of a small helicopter. The device is attached to one end of a standard military M2 supply container currently being used by the Marine Corps for supply drop by parachute. The rotor blades fold back ninety degrees and telescope to one-half their normal length. This permits the M2 container and its Rotochute to be carried on the external bomb rack of a high-speed aircraft.

As soon as the device is dropped, the rotor blades begin spinning automatically and swing ninety degrees to full rotating position. Centrifugal force of the spinning telescoped blades extends them to their full length, and the container comes to earth at a slow rate of descent

MAGNESIUM AIRCRAFT

The first flight of an experimental all-magnesium airplane, an F-80C, has been planned at Mitchell Air Force Base, N. Y., by the Air Research and Development Command. The airframe, constructed almost entirely of magnesium, was built by East Coast Aëronautics, Inc., under contract to the Air Research and Development Command's Wright Air Development Center, Dayton, Ohio.

Engineers list the following possible advantages of a magnesium airframe: (1) It is probably the best substitute known for aluminum; (2) Magnesium is as nearly inexhaustible in supply as any metal known; (3) In applications where buckling is the controlling design consideration, magnesium is probably the most efficient structural material throughout the usable temperature ranges of the light alloys; (4) The thicker skin structure should decrease ground-handling damage and the man-hours required to assemble such a structure since fewer parts are involved, and over-all costs should be lowered.

"AMERICAN INDUSTRY...

our construction power rests upon its strength and ingenuity . . ."

"In this era of world-wide armed truce, when the fate of mankind hangs in the balance, America's tremendous construction power is essential to national survival.

"Deployed under U.S. Army Corps of Engineers' supervision, it was the power that achieved the epic construction of the chain of great Air Force Bases, reaching from the Arabian desert to the Arctic, which today is one of the primary deterrents to World War III.

"Our construction power depends upon the strength and ingenuity of free industrial enterprise. It has demonstrated, in World War II and again in this turbulent period of neither peace nor war, its ability to meet the exigencies of national defense in any quarter of the globe, under any conditions of climate, distance and terrain."

Samuel D. Sturgis Jr.

Statement by Major General S. D. Sturgis, Jr., Chief of Engineers, United States Army

AMERICAN MACHINE & FOUNDRY COMPANY, New York, presents this message as a public service . . . to promote greater understanding of the relationship between the Armed Forces and American Industry.

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STANDARD CYLINDER TUBING

"Mirror Finished" to precision tolerances, it's used in automobile shock absorbers, power steering, hydraulic pumps . . . without further sizing or finishing.

Here's a busy part of an automobile shock absorber that's built for brutal punishment. It's Standard's modern "mirror-finish" Cylinder Tube. So that it won't weaken or leak under punishment, every inch of this tubular "toughie" must measure up to exacting specifications—in cylinder finish . . . in I.D. tolerances as close as .001" . . . in extreme uniformity of wall thickness and concentricity . . . in internal pressure resistance, to shocks up to 9000 P.S.I. The elimination of broaching or further processing of any kind effect significant savings for our customers in product assembly.

As you see here, the engineering involved behind the application of tubing to your product is *more than skin deep at Standard.* Our engineers will gladly show you why in helping you with your tubular application—whether it involves a simple structural or mechanical member . . . or a precision application.

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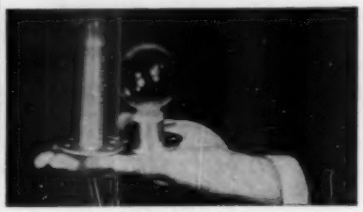
STEEL TUBING SIZES: ½" O. D. TO 5½" O. D. — .028 TO .260 WALL.
STAINLESS SIZES: ¼" O. D. TO 4½" O. D. — .020 TO .154 WALL.

New Developments

EXPLOSION STOPPER

A tiny new electronically controlled device that protects aircraft in combat from fuel-tank explosions has been developed by the Fireye Division of Electronics Corporation of America. The heart of the new device is a miniature, rugged, lightweight photoconductive cell mounted inside the fuel tank of an airplane. The cell



Infrared-sensitive cell, left, triggers fire-extinguishing capsule, right.

detects an explosion by responding to its infrared output the instant it "sees" it. The speed of detection of the explosion can be within one-millionth of a second of ignition.

Coupled with the cell inside the fuel tank of the airplane is an explosive capsule containing a liquid extinguishing agent similar to carbon tetrachloride. When a bullet makes a direct hit on a fuel tank, the cell responds to the infrared radiation of the incipient explosion by counterexploding the frangible capsule to flood the fuel tank vapor space with extinguishing liquid.

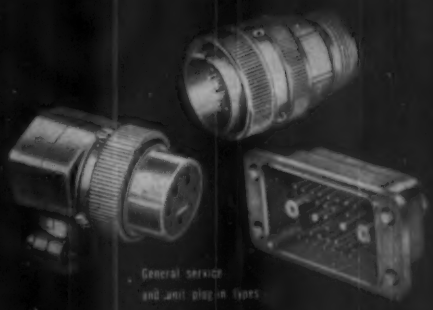
This sequence of events successfully extinguishes explosions with little or no pressure rise so that in a few millionths of a second after the direct hit the explosion is extinguished before it ever really starts.

OCEAN CAR FERRY

An ocean car-ferry type transportation service between the United States and Alaska would be practicable, according to a survey conducted recently for the Army Transportation Corps. The survey, made under contract with the Army by William Wyer and Company, transportation consultants of East Orange, N. J., was authorized in order to broaden the Army's knowledge of coördinated land and sea transport. Such coördination calls for the construction of ships and organization of terminals so that land-type transport can be loaded directly on and off water carriers without additional handling of cargo.

Commercial advantages in the handling of rail cars and motor carrier units lie in reduced costs in transhipping from land to sea and sea to land transport. Militarily, an added advantages lies in the fact that, with the reduction of vessel turn-around time, the concentration of shipping in a port at any one time is thinned out. For the operation, three 18-

connections simplified



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Small as the buttons on your shirt, transistors are already replacing vacuum tubes in applications where size, weight, reliability, and power consumption are important. Newest TI transistor developments are mass production of low cost, high gain germanium transistors and high temperature, high frequency *silicon* transistors. TI silicon devices operate stably to more than twice the high temperature minimums required for most military applications (MIL-T-5422C).

Texas Instruments—with extensive military electronics experience—already has under development numerous military projects applying both silicon and germanium transistors. For aid in the trend to transistorization, call in one of our application engineers. TI welcomes the opportunity to design and manufacture transistorized systems for *your* specific application. Write to Texas Instruments, Apparatus Division.

TWENTY-FIFTH YEAR OF PLANNED GROWTH

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

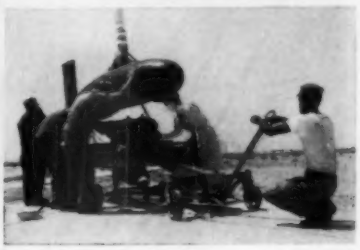
New Developments

knot vessels, each capable of carrying 128 loaded rail cars or highway trailers, were recommended. The vehicles would be loaded and unloaded with heavy-lift cranes mounted on board ship.

PARACHUTE TESTER

A joint Naval and Air Force parachute-testing "whirl tower" has been developed to cut the cost and time required for testing parachutes—mainly those for high-speed jet bail-outs.

Parachutes can be tested on the whirl



Technicians load parachute container into gondola to be swung by the whirl tower.

tower under closely controlled conditions with maximum instrumentation and photographic coverage with reduced cost to the taxpayer. Prior to the whirl tower, a parachute test required two airplanes, one to drop the parachute and another to photograph the drop. In many cases the procedure was not always satisfactory. With the tower, many more chutes can be tested in one day, and all instrumentation and photographs can be readily observed with excellent results.

The tower is a steel structure 130 feet high with a 56-foot boom connected to the top of a rotating vertical shaft. A streamlined gondola is suspended from the boom by a 114-foot steel cable. For operation, the boom with the cable and gondola is rotated. By means of centrifugal force, the gondola which houses the test parachute is swung out and up. The parachute is then released in a predetermined direction at any desired speed up to a maximum of 500 miles an hour.

NEW WAVEGUIDE

A new and radically different medium for transmitting television and telephone conversations over long distances has been used successfully in experiments by Bell Telephone Laboratories. The new medium, a long-distance waveguide, is markedly different from modern cable or radio relay systems—it uses hollow metallic tubes roughly two inches in diameter.

It is believed that the new waveguide may someday simultaneously carry tens of thousands of cross-country telephone conversations along with hundreds of television programs. Top capacity for the

V. I. P.

VERY IMPORTANT PRIVATE

Not rank, but *function,* determines a soldier's importance. This man is carrying, not just a Walkie-Talkie, but perhaps the fate of an army or a cause. Through him headquarters and other units keep informed; through him pass the orders that unite the efforts of many men into one resistless force. By creating, developing and producing a wide range of electronic equipment for all the armed services, RCA scientists and engineers are helping to provide every soldier, sailor, airman and marine with everything that modern electronics can contribute to military effectiveness, safety and comfort. Because the fighter of today must be trained to understand and operate this equipment, his status is higher than ever before and his opportunities correspondingly better.

RCA

GOVERNMENT DEPARTMENT
RADIO CORPORATION of AMERICA
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"Breath of Life" to Air Force Jets

...the MA-1 Portable Starter with C.A.E. Turbine Power

Here's fast, dependable starting for big jet planes—the North American F-100, the McDonnell F-101, the Convair F-102 and the Douglas B-66. The compact unit in foreground is the USAF MA-1 portable air generator, designed and built around the C.A.E. Model 140 gas turbine. Its Continental-developed push-button control makes operation completely automatic.

Basic elements of the MA-1 are single-stage centrifugal flow compressor with two-stage diffuser—one axial and one radial—annular combustion chamber in which fuel is introduced through a slinger integral with main rotor shaft; two-stage axial flow turbine, and accessory drive island in compressor inlet, containing oil pump, fuel pump, governor and transfer gears.

The MA-1 develops approximately 200 air h.p., and this output can be stepped up sharply for applications where higher mass flow is required.

ANOTHER IN A STEADILY-LENGTHENING LIST OF JOBS THAT ARE BEING DONE BETTER BY DEPENDABLE C.A.E. TURBINE POWER.

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MEN WHO LOOK TO THE FUTURE LOOK TO THE AIR FORCE RESERVE

most modern coaxial-cable system is 1,860 two-way telephone conversations or 600 such telephone conversations and 2 TV programs simultaneously on a pair of coaxial tubes. Modern coaxial cables have eight such tubes, two of which are kept as spares for emergencies.

HYPERSONIC RANGE

At the U. S. Naval Ordnance Laboratory, White Oak, Md., is, so far as is known, the only true hypersonic free-flight range in operation anywhere. Here scientists are laying the groundwork for studying the temperature conditions of missiles in free flight. Missile heating is becoming an increasingly important problem as missiles reach higher speeds than ever before. Scientists at the range deal in Mach numbers up to 20 and in temperatures hotter than the face of the sun. Hypersonic flight conditions are simulated in the range by firing a light missile into heavy gases.

SPIN SONDE

A radio transmitter so tiny as to fit with ease in the nose of a 20-mm. projectile and so rugged that it will withstand acceleration shocks of more than 30,000 G's has recently been tested by the Navy. Known as a 20-mm. spin sonde, it will have special importance in studies of projectiles using fins as a means of providing rotation for spin in flight. It will assist in the problem of determining the spin rate as it changes during the flight of these projectiles from zero to maximum. Such information is essential to round out the data needed for calculating the aëroballistic constants.

TARGET SUBS

Target submarines are the smallest employed by the Navy. The T-1 and the T-2 are powered by Diesel engines and carry the same general type of machinery and equipment as Guppies more than twice their length. They are used as targets with antisubmarine forces to test various types of submarine-warfare equipment. They have a crew of 14 men and displace 250 tons for their length of 131 feet. The latest sound-reduction improvements are incorporated.

NEW JET LUBRICANT

A new silicone lubricant with outstanding thermal and load-bearing properties is being vigorously tested by materials and aviation gas turbine engineers of the Westinghouse Electric Corporation. The silicone fluid has satisfactorily passed thermal stability and viscometric tests ranging from minus 65 to plus 500 degrees Fahrenheit. Steel-to-steel bearing load tests have shown the fluid to have excellent lubricating qualities up to 107,000 pounds per square inch bearing area.

N-A-X
ALLOY STEELS

- N-A-X HIGH-TENSILE
- N-A-X ARMORPLATE
- N-A-X 9100 SERIES

For National Defense Equipment

. . . Meet necessary rigid standards

. . . Conserve critical alloys

N-A-X ALLOY STEELS in national defense equipment serve a dual purpose. First, they readily meet the rigid standards so necessary in this type of equipment. Second, while performing capably, these alloy steels do contribute greatly to our national economy through conservation of critical alloying elements.

N-A-X ALLOY STEELS are produced by Great Lakes Steel Corporation—long recognized specialists in flat-rolled steel products.

The Marine Corps' new LVTP-5 is another example of an application of N-A-X ALLOY STEELS.

Courtesy of Ingersoll Kalamazoo Division, Borg-Warner Corporation, Design Agent and Builder of LVT's.

PHOTO-COURTESY OF KALAMAZOO GAZETTE

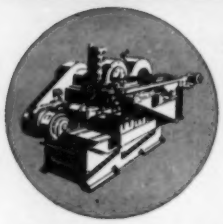
N-A-X Alloy Division

GREAT LAKES STEEL CORPORATION

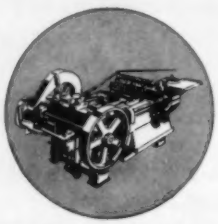
Ecorse, Detroit 29, Mich. • A Unit of

NATIONAL STEEL CORPORATION

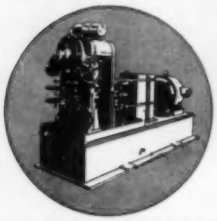
FIVE KINDS OF MASS PRODUCTION METALWORKING MACHINERY by Waterbury Farrel



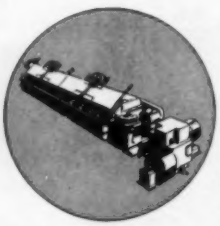
COLD PROCESS BOLT & NUT MACHINERY —Headers (all types) • Rivet Machinery Trimmers • Thread Rolling Machines Slotters • Nut Formers and Tappers, etc.



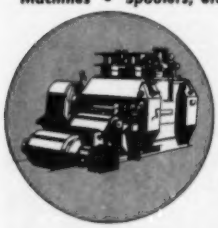
POWER PRESSES —Crank, Cam and Toggle; also Rack and Pinion Presses • Eyelet Machines • Multiple Plunger Presses • Horizontal and Hydraulic Presses, etc.



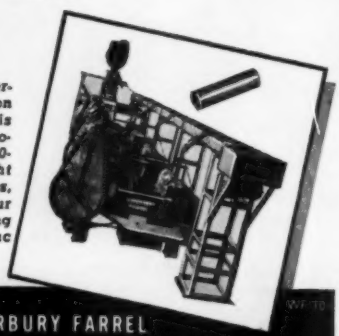
MILL MACHINERY — Rolling Mills: Strip, Rod, Tube, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc.



WIRE MILL EQUIPMENT — Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers • Swagers • Bull Blocks • String-up Machines • Spoolers, etc.



SPECIAL MACHINERY — Sendzimir Mills • Small Arm Ammunition Machines • Thread Rolling Machines For Shells • Collapsible Tube Machines • Coining Mills, etc.



HERE'S A SAMPLE of Waterbury-Farrel mass production equipment in action. This complete WF automatic production unit combines a 40-ton double-acting, upright blanking and cupping press, a conveyor feed and four 7-station horizontal drawing presses to draw 340 zinc shells per minute.

WATERBURY FARREL FOUNDRY & MACHINE CO.
WATERBURY, CONN.
Offices: Chicago, Cleveland and Millburn, N. J.

Book REVIEWS

Reviews in this issue by:

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

COL. CALVIN GODDARD, *small-arms authority, military historian, author, Washington, D. C.*

DR. ARTHUR F. MACCONOCHIE, *educator, mechanical engineer, ordnance authority, University of Virginia, Charlottesville, Va.*

DR. JOHN J. O'CONNOR, *educator, author, editor, Washington, D. C.*

COL. PHILIP SCHWARTZ, *author, ordnance expert, Pasadena, Calif.*

BRIG. GEN. H. N. TOFTOY, *engineer, author, guided missile authority, Redstone Arsenal, Huntsville, Ala.*

BRIG. GEN. THOMAS K. VINCENT, *artillerist, engineer, author, Washington, D. C.*

The Bomb, Survival, and You. By Fred N. Severud and Anthony F. Merrill. New York: Reinhold Publishing Company. 264 pp. $5.75.

THIS work, unfortunately, is unlikely to make the best-seller list. Not only is it too technical for most laymen, but fear has hypnotized many people to the point of resisting any discussion of the atomic bomb.

To all, the authors bring a message of hope. Rather wordily at first, then with increasing clarity and vigor, they proclaim the large hope of survival, in which the inhabitants of even our largest and most vulnerable cities may indulge, especially if we make the necessary preparations.

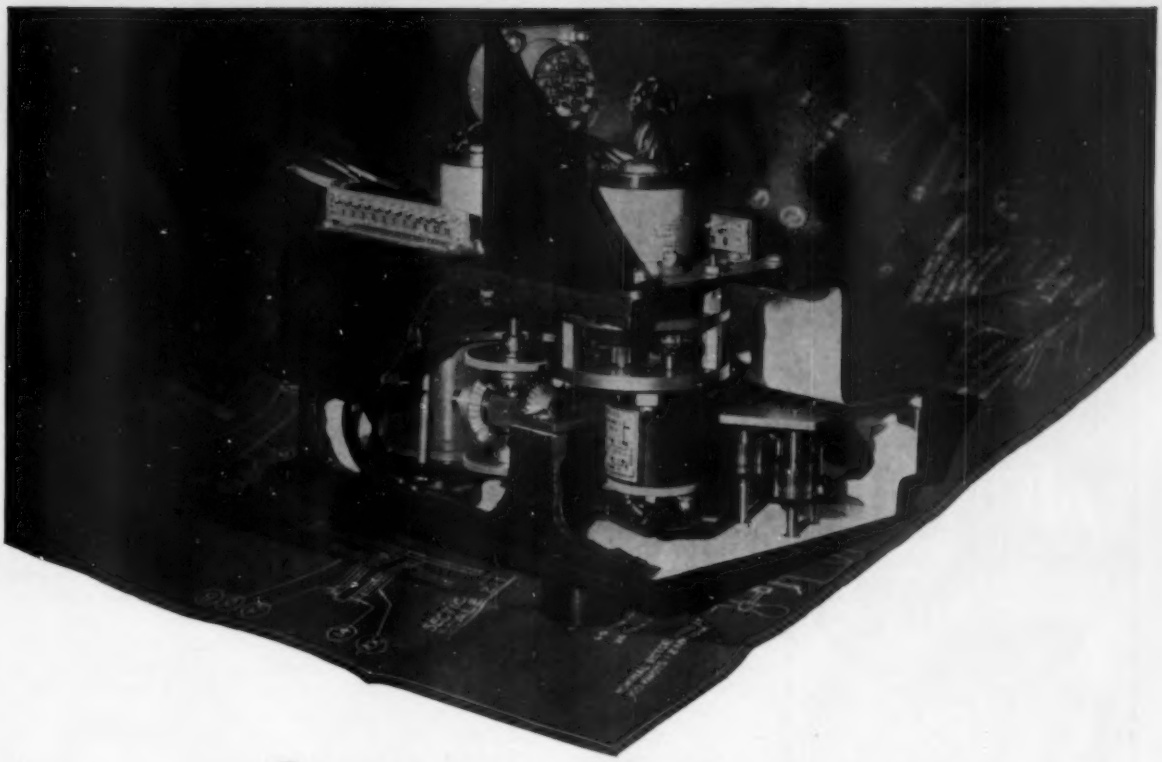
First, there is the problem of strengthening existing structures. This is not only an engineering but a financial problem. Closely allied to building improvements is the provision of convenient shelters. And last but not least in importance is the training of the citizenry in the art of survival during an atomic blast.

The authors' able discussion of the nature of the atomic bomb may serve to dispel some of the awe and mystery which surround it. First, there is the blinding flash of light, having an "intensity many times that of the midday sun," to quote from the War Department's release on the New Mexico test. "With the light flash rides a more sinister atomic force, the gamma ray." Gamma rays are electromagnetic radiations similar to X-rays, and they induce radiation sickness. In the wake of these terrors races the shock wave.

There is a chapter on shelters, which makes the most helpful reading. After all, the prospect of any large-scale alteration of existing buildings to adapt them to the atomic age is none too bright, nor is it likely that many new structures will be built with protection against the atomic bomb in mind.

With few exceptions, however, man is interested in survival, and the authors tell the reader not only what is best to do but what he should not do. In brief, keep out of range of flying glass and, if possible, seek a sturdy corner of the building as the corners are the last to go.

It is disappointing that the dispersal of people through industrial decentralization offers little hope of immediate relief, for economic reasons, since living in the country, remote from



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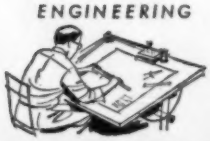

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Book Reviews

great urban centers, is quite the best way to keep on living through atomic attack.

Build yourself a comfortable shelter, according to the specifications approved by the authors, in your back yard or garden, and see that it is properly heated if you mean to spend any time in it. Otherwise your chances of catching pneumonia are far greater than suffering injury from this newest and most terrifying of lethal weapons.—ARTHUR F. MACCONOCHIE.

Development of the Guided Missile. By Kenneth W. Gatland. New York: Philosophical Library. 291 pp. $4.75.

THE British author of this work is an aircraft design engineer and a founder-member of the British Interplanetary Society. He has gathered together a tremendous amount of information on the principles, development, and application of contemporary missiles. The results of his survey are presented briefly and in readable layman's language.

The book is profusely illustrated with photographs of rockets and guided missiles, including a series of forty up-to-date pictures, to scale, of the principal rockets from various countries.

The greatest portion of the book covers the whole range of missiles from free rockets to earth satellites. Various missile propulsion systems and guidance methods are discussed, a well as many of the other details and problems associated with this new art. In the appendix is a ready-reference tabulation of 140 American and foreign rockets and guided missiles, listed alphabetically by name and including the dates, developing agency, and principal characteristics of each project.

In spite of being handicapped by security regulations, Mr. Gatland has, as a whole, covered the subject in a suprisingly extensive manner. Readers who know little about rockets and guided missiles will find this book an interesting means of quickly gaining an understanding of the subject, and it also will serve as an excellent reference work for the initiate.—H. N. TOFTOY.

Jet, The Story of a Pioneer. By Sir Frank Whittle. New York: Philosophical Library. 320 pp. $6.

THIS is largely a condensation of a diary record of the association of the author with the development of the turbo-jet aircraft engine in Great Britain. Technical matters generally have been omitted in favor of descriptions of struggles with engineering problems, with financial difficulties, and with the frustrations arising out of British government procedures.

Sir Frank is given credit in England for being the single individual who did most to expedite the development of jet aircraft engines in Great Britain. He was a Royal Air Force flying officer on active duty from 1928 to 1948, being retired as an air commodore in 1948.

From 1935 until his retirement he spent practically all his working time on jet-engine development. As a reward for his outstanding work he was knighted (K.B.E.) and in 1948 was given an award of 100,000 pounds by the British Royal Commission on Awards to Inventors.—PHILIP SCHWARTZ.

Assignment to Catastrophe, Vol. I: Prelude to Dunkerque. By Maj. Gen. Sir Edward Spears. New York: A. A. Wyn, Inc. 332 pp. $5.

THIS, the first of two volumes recording the disastrous early months that brought Hitler so perilously close to world domination, is written by Churchill's personal representative to the French Government.

General Spears was a retired officer and an active Member of Parliament. As a sworn foe of the "Men of Munich," and a close friend of Churchill, he objectively recounts the well-nigh incredible story of British appeasement and French half-heartedness as seen from a ringside seat.

The impression inevitably is given that virtually all British civilians and soldiers shared in the easy-going attitude that make this period so difficult to understand. It seems almost to have been the result of anesthesia—and terrifyingly parallel to our own people's reaction to the deadly menace of world Communism.

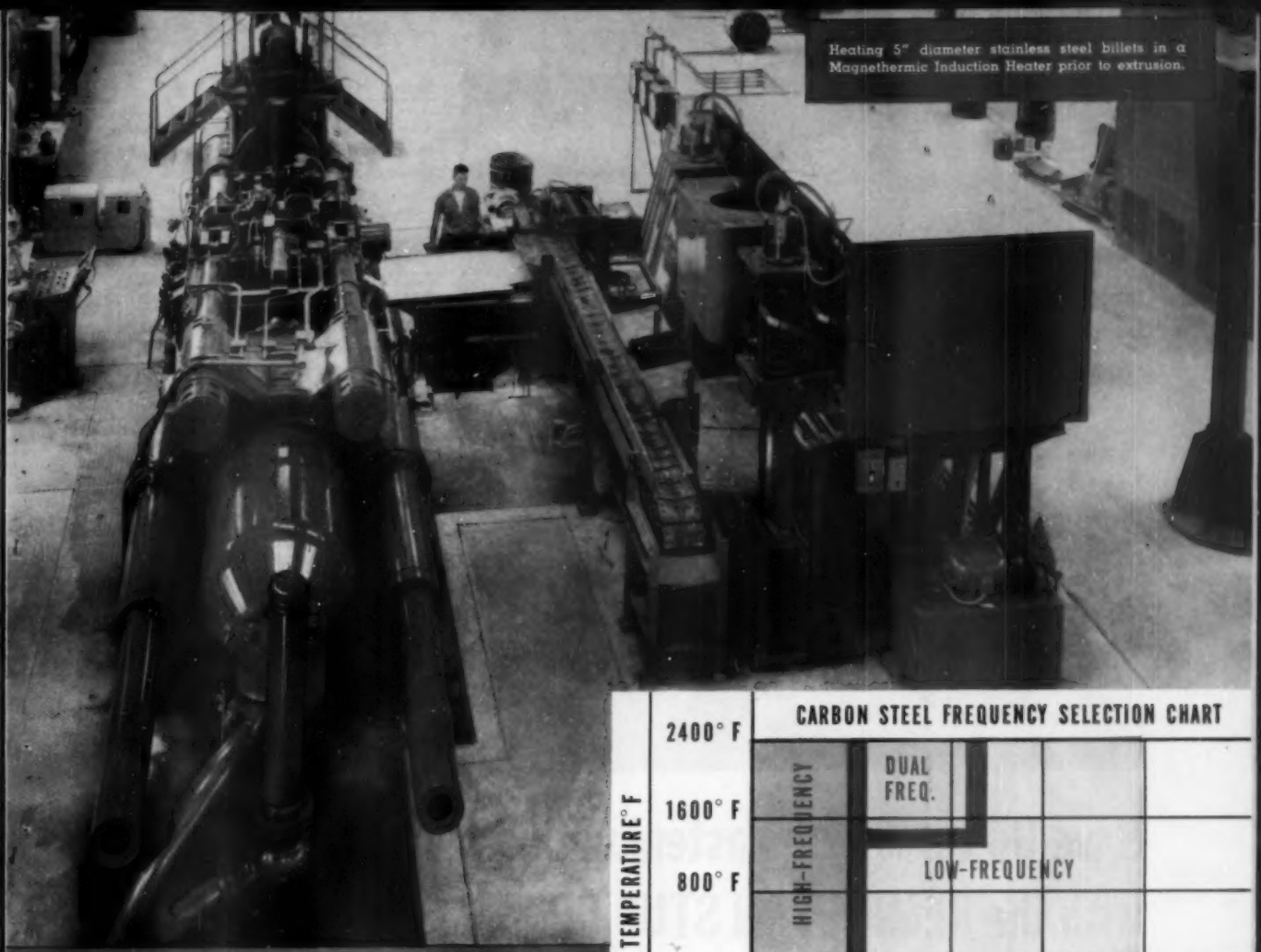
General Spears at times seems unduly preoccupied with personalities; still, his splendid behind-the-scenes story clears up many puzzling points of the tragicomedy. It is significant that De Gaulle is mentioned but four times in this volume—he simply had no part or, rather, he was permitted to play no part.

The stiffening of the British spine at the approach of Dunkerque is apparent; their rally under Winston Churchill's leadership is, perhaps, the sole truly inspiring note of a quite terrifying story. It is a story to make every thoughtful American ponder, shudder, and get busy so that we do not repeat it!—F. W. FOSTER GLEASON.

The Scourge of the Swastika. By Lord Russell of Liverpool. New York: Philosophical Library. 259 pp. $4.50.

IN this atomic age, when the horrors of World War II have faded, one is apt to forget the atrocities perpetuated by the Nazi leaders. Here, in documented form, the details of the atrocities on which the Nazi war crimes were based are repeated.

Well-meaning persons may feel that keeping the memories of these horrible examples of man's bestiality alive will serve no good purpose and that by forgetting them the world will never experience



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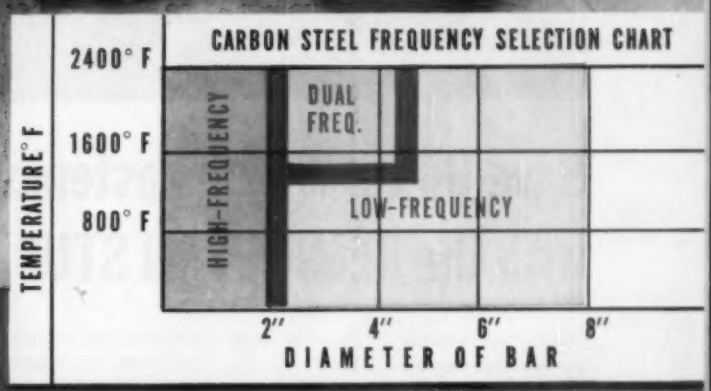

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similar things again. A periodic review of these once-so-vivid acts may alert patriotic citizens to the charge that is theirs that it must never happen again.

This book does just that—makes one aware of what was allowed to happen and diminishes the horror not one whit. It is not pleasant reading, even for the sadistic-minded; in fact, it is controversial in some instances in spite of the documentation. The author has clearly indicated his sources, and reports the facts as culled from them.

The appendix containing the German soldier's "ten commandments," which were printed in every German soldier's handbook and which differ so from the directed or undirected actions of those same soldiers, makes a better epilogue than the one provided by the author.—T. K. VINCENT.

Japan: From Surrender to Peace. By E. J. Lewe Van Aduard. New York: Frederick A. Praeger. 351 pp. $7.50.

ALTHOUGH not completely authoritative, since important source material is not yet available to historians, Baron Van Aduard's objective and detailed study gives us an excellent interpretation of three important postwar problems—the nature of the American occupation of Japan, the writing of the peace treaty in San Francisco in 1951, and the present-day difficulties confronting Japan as it struggles to find its appropriate place within the family of free nations.

Democratic progress in Japan is threatened by three major dangers—the danger of an economic crisis, the danger of overestimating the Communist menace, and the danger of spiritual or ideological confusion. Baron Aduard believes that the free world can do much to assist Japan in overcoming these ever-present dangers, and that Japanese leaders, if they so desire, can attain a leadership and influence in Asia which the free world will welcome.—JOHN J. O'CONNOR.

Soldiers of the American Army. By Fritz Kredel and Frederick P. Todd. Chicago: Henry Regnery Company. 144 pp. 32 plates. $12.50.

THIS new and revised edition of an earlier and considerably more expensive printing (1941) will be welcomed by serious (and less affluent) students of the history of military dress among American land forces from the Revolution to the present day. Far too little information upon the garb of the soldier, and its mutations, has heretofore been readily available.

This reviewer's chief criticism of the Kredel-Todd work is that it illustrates too few examples of that garb. However, it is a most commendable gesture in the

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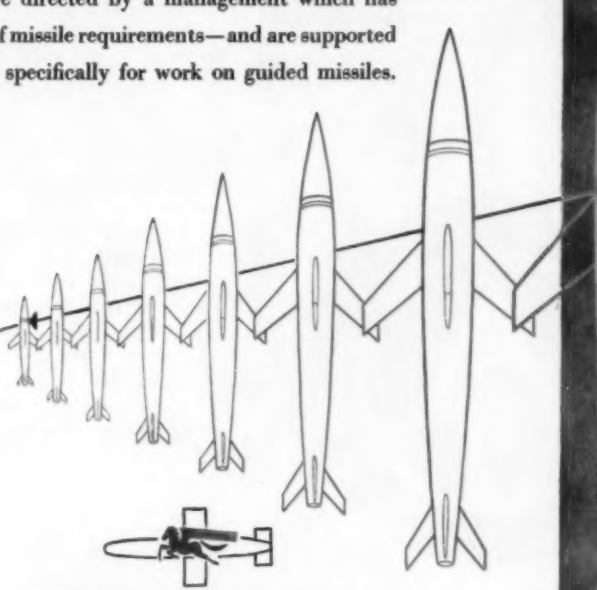

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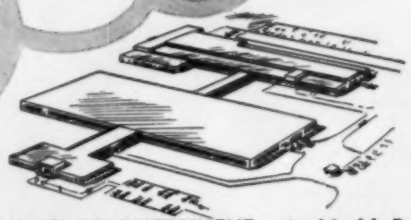

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right direction and will, we trust, be received with the enthusiasm which it so richly deserves.

By way of minor comment and criticism, the documentation for this work, both in the form of footnotes and in the pages of reference following the final plate, seems both apt and comprehensive. On the other hand, the absence of page numbers is confusing.

Again, one could wish that certain uniforms, rather than others, might have been chosen for illustration. Thus, since the Ancient and Honorable Artillery Company of Boston is the oldest of the "independent" (nonfederalized) units in the country, it would, I believe, have been appropriate to devote a plate to it rather than to one of the other similar organizations which has been favored.

In the matter descriptive of Plate 23 (7th Cavalry, 1876), we read: "Many of the Sioux were armed with repeating Winchester rifles of a far greater range and faster rate of fire than the Springfields carried by the cavalrymen."

I concede, of course, the greater rate of fire. But the first model of the Winchester which could remotely hope to approach the range of the .45-70 Springfield carbine which Custer's men carried (and which, even at 900 yards, practically equaled in accuracy its much longer barrelled brother of infantry issue), was the model 1876 in caliber .45-75. That model was not even unveiled to the public until the opening of the Centennial Exposition in Philadelphia on May 10, 1876. That specimens could have been in the hands of the Sioux on June 25th seems almost impossible of belief.

Our authors are to be commended for including plates depicting such rarely illustrated uniforms as those of the Texas Rangers (1846), the Mexican Spy Company (1847), various Confederate Army units, and the Federal Corps D'Afrique (1864). I'll warrant that it would require extensive research to uncover these in any other reference volume readily available to the average student—provided they could be located at all!

Once again, hats off to Kredel and Todd. May they live long and prosper!—CALVIN GODDARD.

Arms Trade Yearbook, 1955. Compiled by Paul Wahl. Bogota, N. J.: Paul Wahl Associates. 78 pp. $2.

THIS little compilation is a reference for American and British producers, dealers, collectors, smiths, associations, and all connected with dealing, trading, or handling small arms and ammunition. It will be a valuable guide to any who have dealings on the subject. A brief digest of Federal and State firearms laws and the

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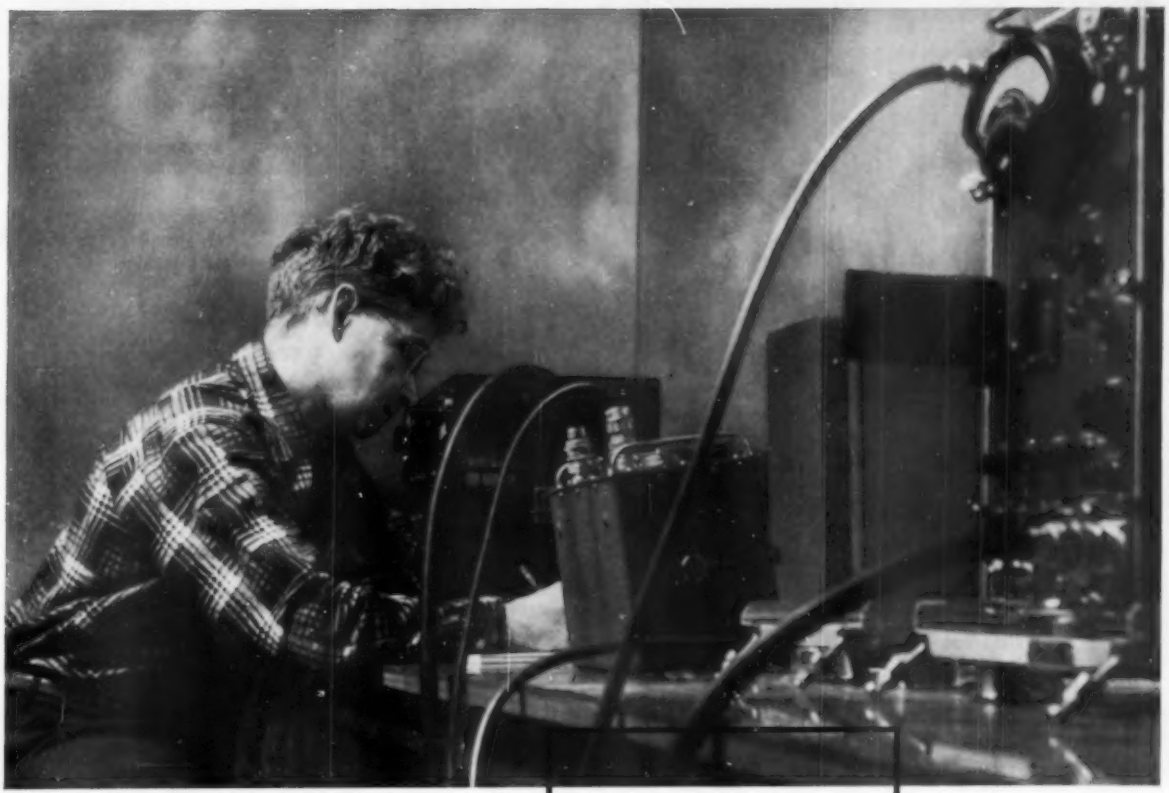

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hunting regulations which apply to arms are featured.—F. W. Foster Gleason.

Stephen R. Mallory. By Joseph T. Durkin, S. J. Chapel Hill: University of North Carolina Press. 446 pp. $6.

THIS is the first full-length biography of the Secretary of the Navy of the Confederate States of America whom Douglas Southall Freeman regarded as one of the ablest men in Jefferson Davis's Cabinet.

Mallory grew up in Key West, Fla., where his mother kept a lodging house. With only a few years of formal education he became successful in practically everything he undertook as a lawyer, land owner, dealer in real estate, and political leader.

Perhaps Mallory's chief claim to fame was his keen realization of the utility of ironclad vessels and his promptness in building them. His department also developed the torpedo (the modern mine), one of the really great inventions of the Civil War and the most consistently successful of all Confederate weapons.

Father Durkin's carefully documented biography adds considerably to our knowledge of a little-known aspect of Confederate history. The chapter on Confederate naval ordnance is particularly valuable.—John J. O'Connor.

BOOKS RECEIVED

A.S.T.M. Standards on Copper and Copper Alloys. Sponsored by A.S.T.M. Committee B-5 on copper and copper alloys, cast and wrought. Philadelphia: American Society for Testing Materials. 600 pp. $5.

Behavior of Metals under Impulsive Loads. By Mohn S. Rinehart and John Pearson. Cleveland: American Society of Metals. 256 pp.

Chemical Business Handbook. Edited by John H. Perry. New York: McGraw-Hill Book Company. 1,323 pp., plus 31-pp. index. $17.

Civil-Military Relations. An annotated bibliography, 1940-1952. Prepared under the direction of the Committee on Civil-Military Relations of the Social Science Research Council. New York: Columbia University Press. 140 pp. $2.

Formulas for Computing Capacitance and Inductance. By Chester Snow. (Circular 544, National Bureau of Standards.) Washington: U. S. Government Printing Office. 69 pp. 40¢.

The Four Wheel Drive Story. By Howard William Troyer. New York: McGraw-Hill Book Company. 215 pp. $4.

Glass Reinforced Plastics. Edited by Philip Morgan. New York: Philosophical Library. 248 pp. $10.

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Miniature Intermediate-Frequency Amplifiers. By Robert K-F Scal. (Circular 548, National Bureau of Standards.) Washington: U. S. Government Printing Office. 46 pp. 40¢.

Nuclear Geology. Edited by Henry Faul. New York: John Wiley & Sons, Inc. 414 pp. $7.

Optical Image Evaluation. National Bureau of Standards. Washington: Government Printing Office. 289 pp. $2.25.

Permissible Dose from External Sources of Ionizing Radiation. National Bureau of Standards Handbook 59. Washington: U. S. Government Printing Office. 79 pp. 30¢.

Protection against Radiations from Radium, Cobalt-60, and Cesium-137. National Bureau of Standards Handbook 54. Washington: U. S. Government Printing Office. 60 pp. 25¢.

Radioactive-Waste Disposal in the Ocean. National Bureau of Standards. Washington: U. S. Government Printing Office. 31 pp. 20¢.

Refractory Hard Metals. By Paul Schwarzkoph. New York: The Macmillan Company.

Report on the Elevated-Temperature Properties of Selected Super-Strength Alloys. Data prepared for panel by Ward F. Simmons and Howard C. Cross. Special technical publication No. 160. Philadelphia: American Society for Testing Materials. 208 pp. $4.75.

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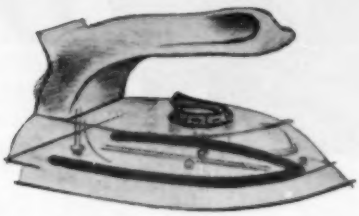
Ultrahigh Frequency Propagation. By Henry R. Reed and Carl M. Russell. New York: John Wiley & Sons, Inc. 554 pp. $9.50.

Weapons: A Pictorial History. By Edwin Tunis. Cleveland: World Publishing Company. 152 pp. $4.95.

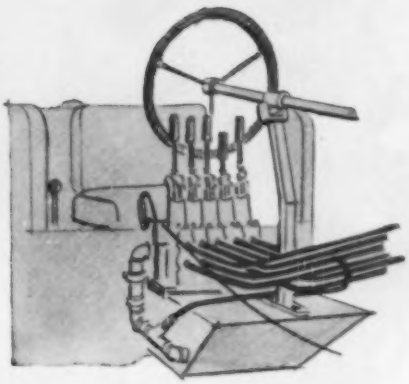
Wind Tunnel Testing. By Alan Pope. New York: John Wiley & Sons, Inc. 511 pp. $8.50.

BUNDY TUBING COMPANY

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*



SHEATH FOR HEATING ELEMENT IN HAND IRON



HYDRAULIC CONTROL GROUP IN ROAD GRADER

REMARKS Designing a new product? Or redesigning an old one? Why not avoid delays, expense by turning your tubing headache over to our engineering experts. They offer you a wealth of problem-solving experience, plus the priceless bonus of Bundyweld, the only tubing double-walled from a single strip (see below).

WRITE today for catalog or for help in developing your tubing application.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

FRAME FOR TYPING TABLE

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.:*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., E. • **Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.**

We tie truck axles in

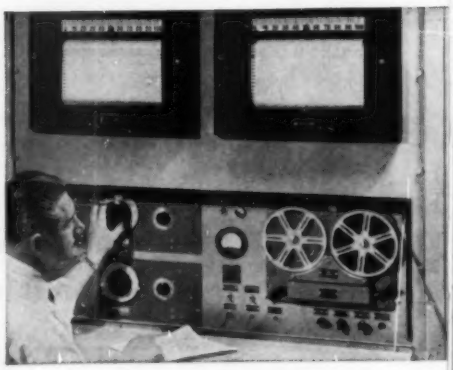
in the new Timken-Detroit indoor proving ground . . . and only

We torture them . . . shock-load, over-speed and jerk them . . . twist, strain and abuse them. We match every on-the-job hauling condition . . . then throw in a few devilish tricks of our own!

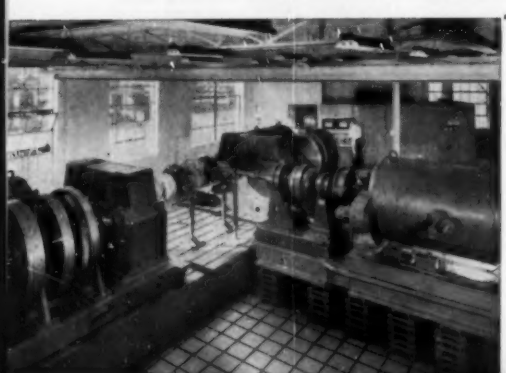
The result? You know for sure that *any* Timken-Detroit axle can take more abuse on the job it was built for than any other axle made!

To prove it, we moved a huge proving ground indoors. In one room we can simulate any hauling situation — our engineers can apply 50 years of experience to perfecting axles for modern trucks, buses and trailers, and measure performance with scientific precision.

This research pays off in longer truck life; less maintenance, repairs and downtime; lower operating costs. No wonder Timken-Detroit axles with Hypoid gearing rate "first" with wise truck owners!



This is our "truck driver." He works in our "Torture Chamber." Above him are graphs showing speed and torque performance under any operating condition he chooses . . . soft ground at full load . . . mountains . . . express highways or side roads. With special dials, recorders and electronic devices, he actually *drives* the axle with scientific accuracy from his chair!



How TDA proves axle quality in this "Torture Chamber"

We pick one of our axles at random . . . then duplicate a hauling condition, hour after hour, day after day . . . simulating half a million miles of the toughest driving situations in just a few days. Or "invent" a test like going uphill with a full load from California to New York nonstop. There is no other axle testing like it in the world!

No matter the twist, thrust or shock...Timken-Detroit axles can take it! Regardless of load, road and speed conditions... even the impossible... the new Timken-Detroit Straight-Line Drive for the 2½-ton, 6 x 6 military truck is a vastly improved unit.

On Timken-Detroit axles... you go anywhere you gotta go... and with power and stamina. You can't be choosy in combat... and you can't afford breakdowns in schedules *or* the vehicle. And every day, continuous research is adding even greater performance to the 6 x 6.

What's more...

INTERCHANGEABILITY...

of parts for easier logistics

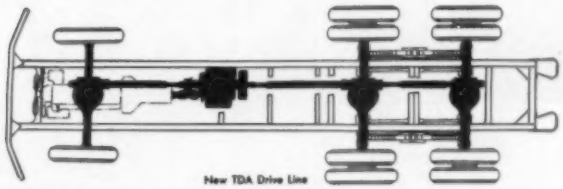
1. **A simpler logistics problem of stowage and palletizing.**
2. **Fewer different parts in stock bins—of vital necessity to military supply officer who must maintain a warehouse on wheels.**
3. **Far greater ease of maintenance.**
4. **Fewer records of parts and service operations to maintain.**
5. **Reduced personnel training time in operation and maintenance.**
6. **More personnel made available for other duty.**
7. **Faster availability between manufacture and use.**

knots

Timken has it!

Interchangeable Final Drive Unit—The same type of rugged Double-Reduction Final Drive, formerly used so successfully only in heavy-duty military trucks, is a feature of the Timken-Detroit equipped 2½-ton 6 x 6 truck.

Gear reduction is accomplished in two steps giving increased torque and shock-load capacity. Bevel gearing is used for the first reduction and helical gearing for the second reduction.



New TDA Drive Line

Here's what makes the Timken-Detroit 6 x 6 assembly "tick"

The new design features a straight-line drive from the front axle through the transfer case to *both* rear axles. This is possible because top-mounted double-reduction final drives are used on all three axles. Ground clearance is increased... propeller shaft angles reduced vertically and horizontally.

This double-reduction final drive permits a gearing arrangement which makes possible the through-drive design. Power is thus transmitted in a straight line from the transfer case to the first rear axle and through this axle in a straight line to the second rear axle and likewise in a straight line to the front axle. This eliminates the need of pillow blocks and another set of propeller shafts and accomplishes a degree of interchangeability of parts that cannot be otherwise obtained.

Final drives in all three axles are *identical* and *interchangeable* and are easily removed from the housing for service.

TIMKEN *Detroit* AXLES

TIMKEN DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

Accepted Standard

TRADE MARK REGISTERED

Plants at: Detroit, Michigan • Oshkosh, Wisconsin Utica, New York • Ashtabula, Kenton and Newark, Ohio • New Castle, Pennsylvania

if you need ... LARGE AND MEDIUM-SIZED SEAMLESS STAMPINGS

we offer ... SKILL ... MEN ... MACHINES ...

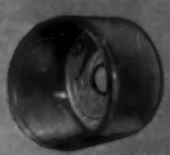
plus complete finishing and assembly facilities

Send for your free copy of our booklet—"Science and Skill in Sheet Metals." It illustrates many jobs produced for G. P. & F. customers ... and gives interesting information on our abilities and facilities.

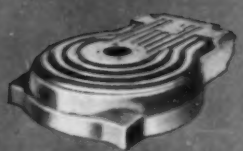
Do you have a metal product—or a part of a product—that has to be stamped or drawn? Then it's time to take a good look at what G. P. & F. has to offer. We have the manpower, the machines, the facilities. We can handle your *complete* job from start to finish—relieve you of production details and responsibilities—even package and ship your finished product, if you wish. The booklet shown on the left tells the complete story. Write for it today!

G.P.&F.

Here are just a few samples of our work...



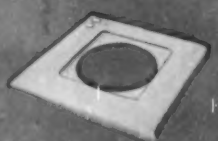
OVERFLOW TUB FOR AUTOMATIC WASHING MACHINE
Welded Construction
Vitreous Enameled
Height, 21"—Diameter, 24"
(Also conventional and spin tubs)



BASE FOR POWER LAWN MOWER
Seamless Drawn Steel
Length, 26"—Width, 19⅛"
Height, 4⅜"

AMMUNITION BOX
(U.S. ORDNANCE)
Carbon Steel—Spray Painted
Length, 10"—Height, 7"
Width, 3⅝"

POWER TOOL SAFETY GUARD
Seamless Drawn
Length of Cover, 29¾"
Height of Cover, 5¼"
Width of Cover, 10⅛"



TOP FOR AUTOMATIC WASHING MACHINE
Stainless Steel and Vitreous Enameled
Length, 26"—Width, 25"
Height, 2½"
(Also dryer tops)

SYRINGE HOLDER
Stainless Steel Box, Cover and Rack
Length, 8¼"
Height and Width, 5"

BASE FOR SWIVEL CHAIR
Seamless Drawn Carbon Steel
Length, 25"—Height, 4"

COMMERCIAL HAND DRYER
Seamless Drawn—Vitreous Enameled
Length, 12"—Width, 10½"
Height, 6⅛"

GEUDER, PAESCHKE & FREY CO., 1327 W. St. Paul Avenue, Milwaukee 1, Wisconsin

ELECTRONIC DRA
GUI

For the firs
deadly elec
with Mach
guidance sy
m.p.h. in th
getting into

Launching r
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ing on the la
U.S. defense

RAYTHEC

RAYTH

MEMORANDUM
Office of the President

1/4/55

JLH: CANCEL THIS AD---

There is a big story here - and nothing in it actually classified - but what will be gained by publishing it?

It might give comfort to the communists to tell them anything at all about our missile work.

The equipment Raytheon is producing for the security and defense of the country is so ~~important~~ vital that we can't afford to take any risks.

It seems to me there is a message we should print, however—one in which every American can take pride and confidence: Raytheon's government contracts are being carried out by many of the nation's ablest scientists, engineers and workers. These fine people have a deep respect for the quality of the electronic equipment they make. They know its importance to the welfare and safety of a free people. What do you think?

Jack -
This is a matter of policy -
- Please see me -

C. F. Adams, Jr.

RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS.

Building machines is our business. Each of the four divisions comprising Emhart Mfg. Co. is a leading manufacturer in its field. Each is equipped with the most modern machine-building equipment and staffed with people who know how to produce precision machines. The combined experience of all four divisions totals 196 years — and all of it is in production machinery.

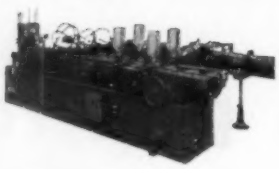
AT YOUR SERVICE 196 YEARS OF EXPERIENCE IN BUILDING MACHINES

Each division is busy, but each is geared — and has the space and manpower — to assume additional production work. All four divisions have had extensive experience in manufacturing for military requirements either through prime or sub-contracts.

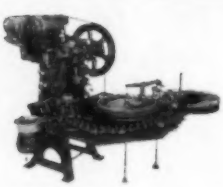
Your investigation of our facilities for manufacturing projects is invited. Our central production group is available for consultation at your convenience. For more details on our diversified manufacturing experience, please write for our condensed catalog of over 275 machines.

On this machine .45 caliber ammunition is unscrambled and positioned for cartoning. Two-piece cartons are applied manually to complete the package.

100-ton progressive dieing machine produces .50 caliber ammunition chute components complete.



Carton Inserter automatically loads products into cartons at high speed.



Long-slide power press with dial feed produces complete hearing aid batteries.

Only the best is good enough

EMHART

S-K

CONTRACT MANUFACTURING DIVISION

EMHART MFG. CO.

333 Homestead Ave., Hartford 2, Conn.

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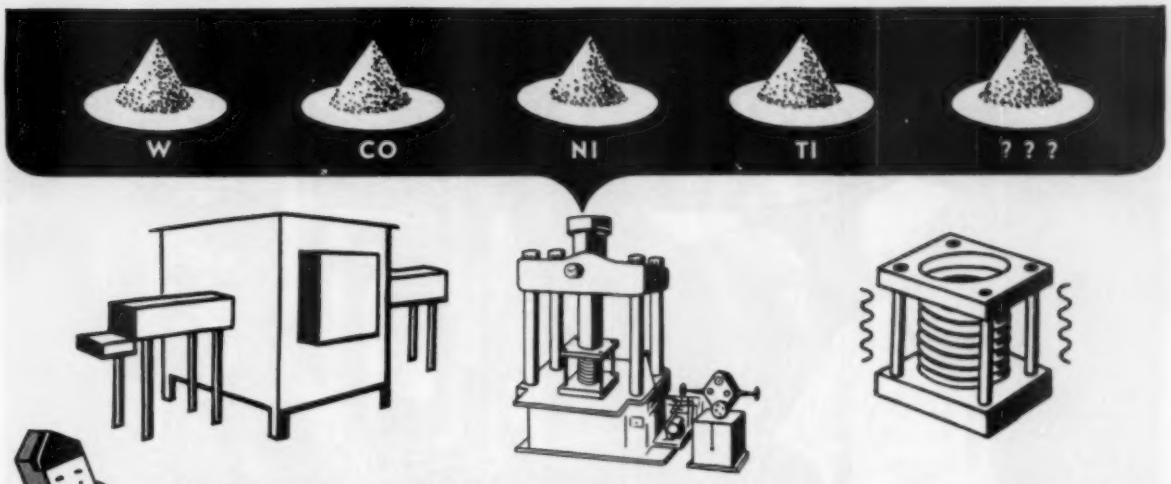
HENRY & WRIGHT	STANDARD-KNAPP	THE V & O PRESS COMPANY	HARTFORD-EMPIRE COMPANY
Hartford, Connecticut	Portland, Connecticut	Hudson, New York	Hartford, Connecticut



Cold Press and Sinter or Hot Press or Vacuum Sinter!

25 Years of Powder Metallurgy EXPERIENCE FOR SALE!

THE PROBLEM — Industry and Government are engaged today in a gigantic effort to develop new alloys and stronger metals. The future security of America depends on the success of this program. Powder metallurgy, possessing unique advantages not common with any other process, can solve many of the tough metallurgical problems created by the jet age.

THE FACILITY — Metal Carbides, a pioneer in powder metallurgy, is well qualified by the experience of the past 25 years to help solve your particular problem. Our modern, well-equipped plants of over 100,000 sq. ft. are at your disposal, manned by skilled technicians and metallurgists capable of performing every technique known to powder metallurgy. Here are the facts:

THE PROCESS — Our equipment is varied and complete. Cold pressed and sintered parts can be processed in a vacuum or controlled atmosphere. Hot pressed parts can be produced up to 30" in diameter, up to 100" in length, and up to 5000 lbs. Other available processes include vacuum casting, centrifugal casting, hot forging and vacuum impregnation.

THE MATERIAL — Our experience covers the processing of carbides of tungsten, titanium, tantalum, molybdenum, chromium and columbium. Extensive experiments have also been conducted with various borides, silicides and oxides. Combinations of metals and ceramics have been developed which show great promise, and new possibilities seem unlimited.

THE ANSWER — Metal Carbides has found that by combining the best features of the above processes — with the right combination of metals and materials — totally new advantages result. Whether you require a structure that is porous, dense or tough — or a material that will withstand heat, corrosion or shock — let us put our experience to work helping you reach your objective! **Metal Carbides Corporation, Youngstown 7, Ohio.**

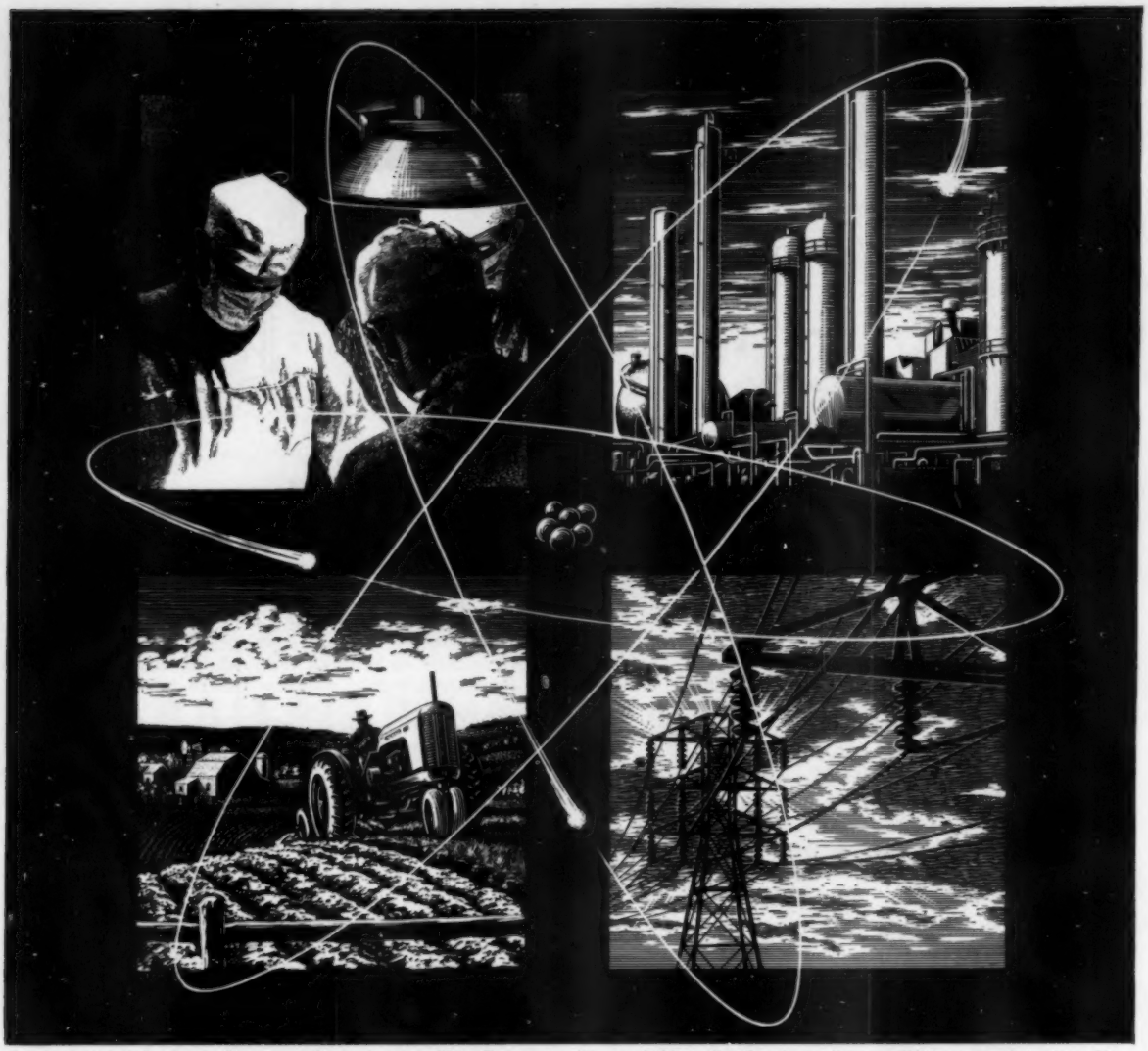
Send for new 84-page Catalog No. 55-G.

COMPRESSOR BLADES AND TURBINE BUCKETS FOR JET ENGINES

WIRE, WRITE or PHONE particulars of your problem or objective and we will advise promptly what our Powder Metallurgy technique can do for you.

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 7, OHIO

HOT PRESSED AND SINTERED CARBIDES · VACUUM METALS
HEAVY METAL · CERMETS · HIGH TEMPERATURE ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



Engineers: North American offers unusual opportunities. Write Engineering Personnel Office, Los Angeles or Downey, California; or Columbus, Ohio.

THE PEACEFUL ATOM...IT'S WORKING FOR YOU!

North American Aviation early saw the need for development and application of the atom to peaceful purposes. Using its own funds, the company set up an organization staffed by leading atomic scientists and engineers. This Nuclear Engineering and Manufacturing organization conducts work for the Atomic Energy Commission and has initiated many new developments in nuclear applications.

This continuing effort has produced several types of research reactors. Two important examples of these, produced for the Atomic Energy Commission, are now in operation. One is being used by the company for advanced developmental study of other reactor designs, and general nuclear research is being done with the other. Other North American designed reactors for industrial and medical research will soon be in operation.

Still another example of North American's advance in this field is the "Sodium Reactor Experiment," a new reactor concept in atomic power. This development is being jointly financed by the Atomic Energy Commission and the company. From this will come many answers to the problem of producing economical electricity from the atom.

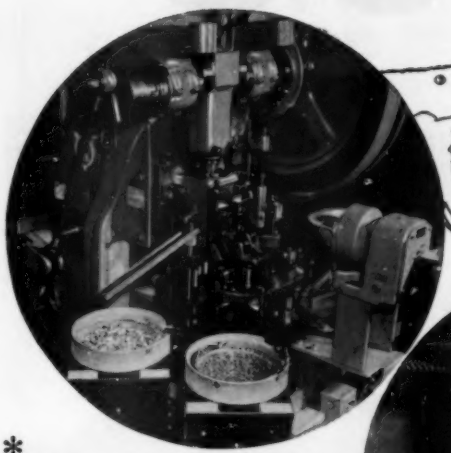
ENGINEERING AHEAD FOR A BETTER TOMORROW

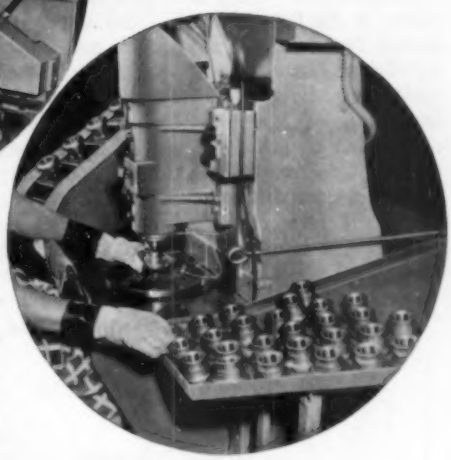
NORTH AMERICAN AVIATION, INC.

Blueprints call for bearings?

Call on NEW DEPARTURE

PDQ*!





* **PRICE!**—Savings of automation in New Departure plants are reflected in prices impossible with less modern methods. Here a unique machine automatically assembles refrigerator door bearings . . . with notable savings for the buyer.

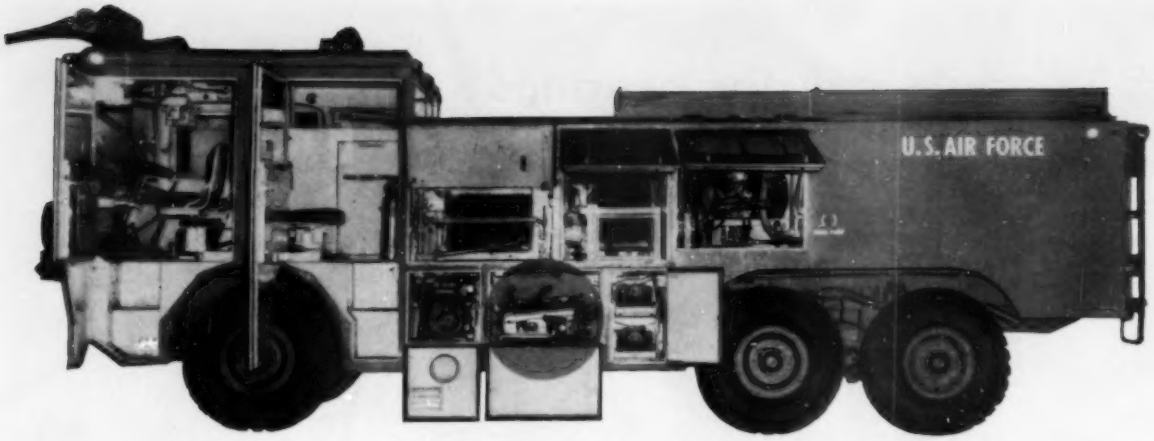
* **DELIVERY!**—Electronics work at New Departure! Bearing races are speedily sorted into six dimensional classifications by this machine. Volume is up because New Departure invested in this modern equipment.

* **QUALITY!**—Painstaking quality control, at every manufacturing step, works to approach perfection in every bearing. Here you see an electronic inspection of operational noise level. Any sub-standard part is automatically rejected. There's no chance for error. You are sure of top quality —every time!

PLUS ENGINEERING SERVICE—There's no substitute for experience . . . and New Departure offers you an unmatched backlog of accumulated ball bearing knowledge. So whenever the prints call for ball bearings, check with New Departure for engineering assistance in bearing selection and application. Phone, wire or write . . . you'll get action from New Departure—PDQ!

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

NEW DEPARTURE
BALL BEARINGS
NOTHING ROLLS LIKE A BALL.

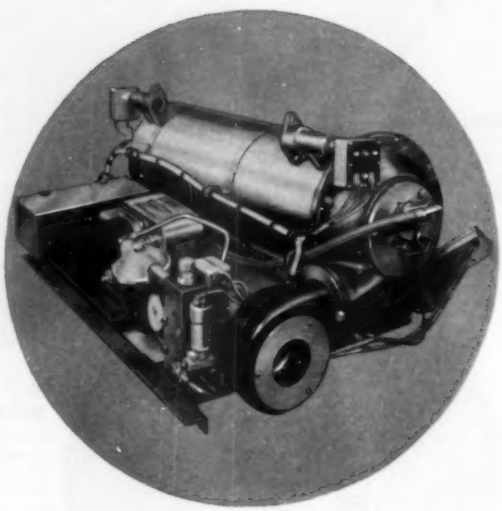


everything has to work...and it does!

Test personnel of the Air Proving Ground Command recently returned after more than 1000 hours of Operational Testing on the Type 0-11A USAF Crash Truck built by American-LaFrance-Foamite. A Janitrol 90,000 Btu/hr. Liquid Heater is standard equipment on this all-weather vehicle, and supplies all heating requirements.

No difficulties of any kind were experienced with the Janitrol heater in the 0-11A Crash Truck during the entire artic test period. Not once was any service necessary! Defrosting of the windshield was adequate with the assistance of the wipers in combatting the after-squirt from the turret dispenser nozzles. In a minus 41°F ambient temperature cab comfortization was maintained at plus 66°F, and in addition the Janitrol Heating Unit provided standby heat for the vehicle engine, pump engine, hose reel compartments, battery compartment and auxiliary power generator compartment. The main water storage tank was protected from freezing by a heat exchanger submerged in the tank.

No matter what kind of heat you may need—specify "Janitrol" and be sure of performance and dependability.



HEAT WHEREVER YOU WANT IT

Janitrol

AIRCRAFT-AUTOMOTIVE DIVISION, SURFACE COMBUSTION CORP., COLUMBUS 16, OHIO

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AND PAY LESS THAN EVER BEFORE—

$5 annual dues in 1920

$4 annual dues in 1930

only $3.33 *a year today!*

*(at the special rate of three years for $10.00)

WHY NOT TELL A FRIEND ABOUT THE A.O.A. TODAY?

American Ordnance Association

708 Mills Building, 17th and Pennsylvania Ave., N.W., Washington 6, D.C.

Why you should now

TAKE A CLOSER LOOK AT ALUMINUM FORGINGS

MORE and more manufacturers are finding that aluminum forgings are now the logical choice for many parts that move under stress.

This is true because larger parts, and more complex ones, may now be forged in aluminum.

For example, whole sub-assemblies may be replaced with a single aluminum forging, thus often greatly reducing production costs of the finished product.

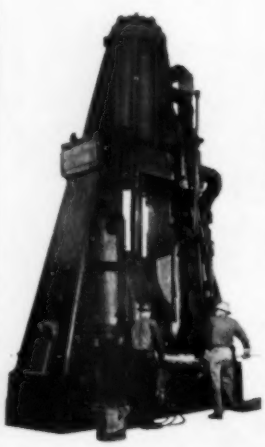
You should take steps now to see where the greater use of aluminum forgings can give your products the additional benefits of light weight, high strength, dimensional uniformity, and corrosion resistance.

A Kaiser Aluminum engineer, skilled in die and forging design, will be glad to help you at no obligation.

Take advantage of Kaiser Aluminum Forging Consultation Service without delay. For immediate attention, contact any Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc. *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

setting the pace—in growth, quality and service



Better service for users of forgings

Kaiser Aluminum's recently-acquired Erie forging plant—one of the nation's three major aluminum forging plants—is now providing industry with a continuing supply of high quality aluminum forgings, plus nationwide service.

The Erie plant can produce aluminum die forgings from the smallest size up to 150 pounds as well as hand forgings up to 700 pounds, and has a rated capacity of 12 to 15 million pounds per year.

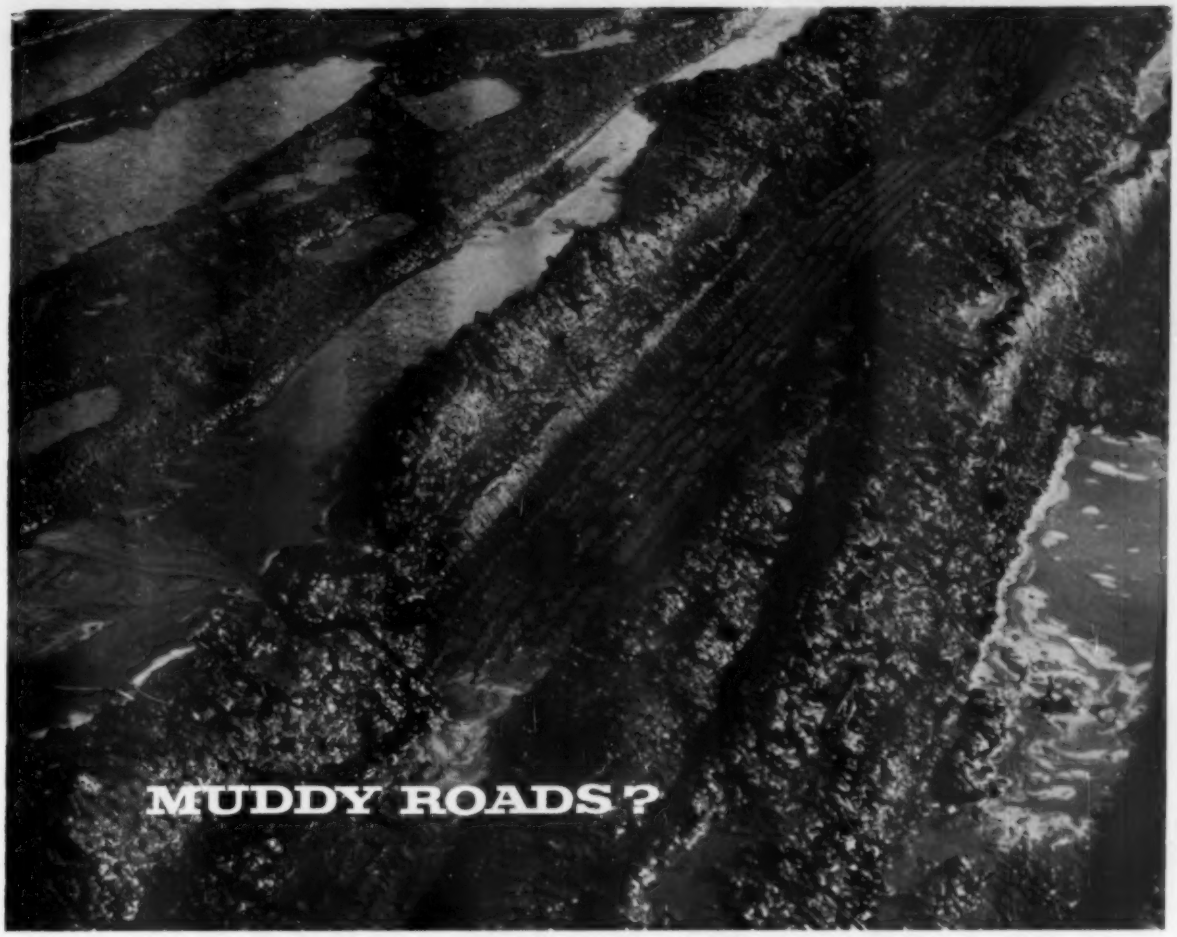
For years, Kaiser Aluminum has been a major supplier of aluminum in many forms. The acquisition of the Erie plant makes it possible for us to bring important benefits to users of forgings.

Sales service—The addition of aluminum forgings to our wide range of mill products enables our nationwide sales force to increase its service to our customers. Personal attention is given to every order from the time it is received until the forging is delivered to the customer.

Engineering service—We are increasing the present staff of experienced engineers. These men are highly skilled in die and forging design and are available for customer consultation.

Quality control—Trained laboratory technicians, using the most modern testing methods and equipment, assure highest quality forgings to meet rigid specifications.

Production control—The most modern methods of production control are employed to expedite material flow, die making, forging and finishing operations, thus insuring maintenance of shipping schedules.



...Not if you know where you're going!

Research pioneers today travel over difficult terrain as pioneers must always do, in unexplored by-paths of optics, magnetics, electronics and electro-mechanics. For every striking advance there is likely to be the other kind of project that bogs down into a time-and-money-wasting quagmire.

Since 1937 Librascope has developed successful projects in *all* of these fields, including weapons systems for defense and industrial controls for industry. Librascope has an engineering staff consisting of specialists in each of these fields, trained to work as a unit. We would welcome the opportunity to join your team for the hard pull over the gray areas. Complete facilities, including men, equipment and production techniques are available to assist in all technical projects of industry and government.

Librascope weapons systems and components for fire control, and navigation devices involve mechanical, electrical, electronic, magnetic and optical techniques. Also industrial control systems and computers.

ENGINEERS: *Interesting profitable California careers at Librascope. Write Mac McKeague, Personnel Director.*

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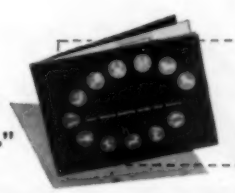

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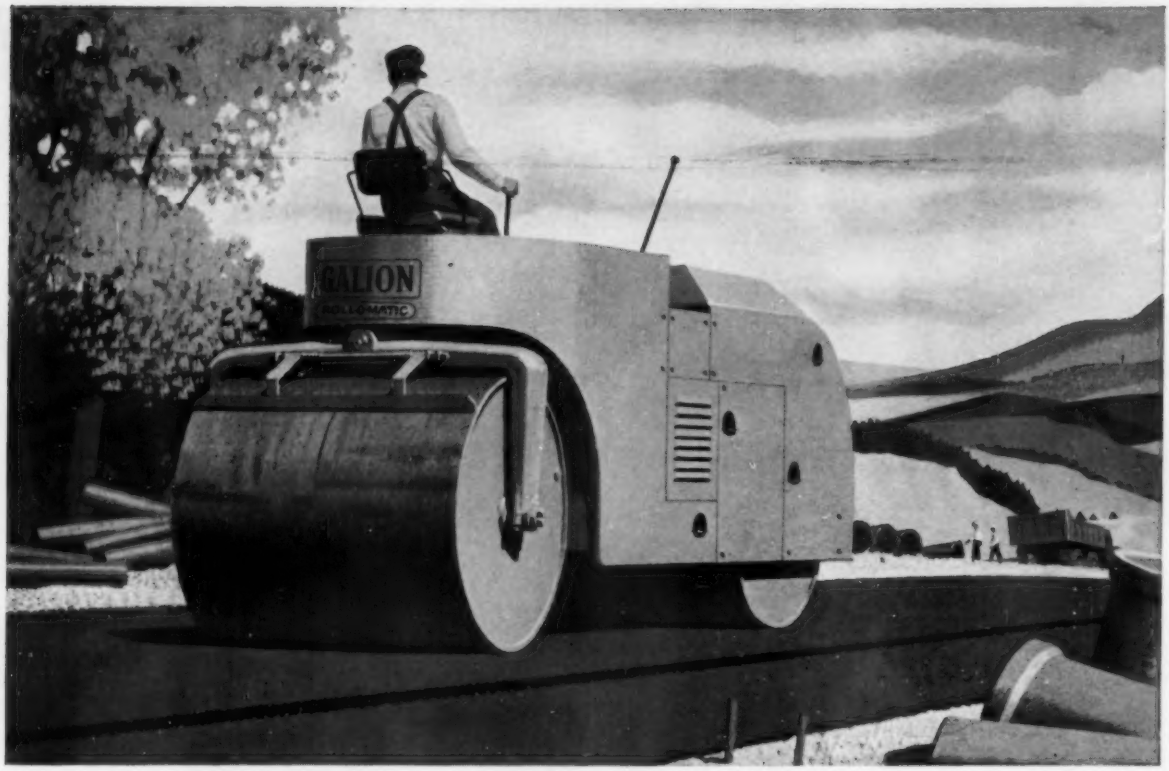


NEW GALION ROLL-O-MATIC WITH TORQMATIC CONVERTER

rolls 10% more surface per day

GALION — one of the world's largest manufacturers of road rollers—now offers four new gasoline-powered ROLL-O-MATIC tandem rollers equipped with Allison TORQMATIC Converters.

This efficient combination torque converter and fluid coupling makes ROLL-O-MATIC simpler to operate. It eliminates the master clutch. There are no gears to shift.

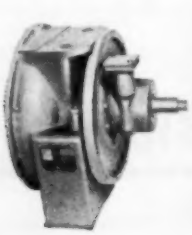
ROLL-O-MATIC rolls smoother in either direction. With the governor directly on the tailshaft it has quicker pickup —takes guesswork out of reversing. Rolling speed is automatically maintained up hill—on the level—down hill and on curves, by means of the combination of the TORQMATIC Converter and tailshaft governor.

The maker reports the operation is so smooth that at least 10% more surface can be rolled per day. And fuel consumption is reduced as much as 25%.

The applications of Allison TORQMATIC Converters are broadening rapidly. With units in a new range from 40 to 150 horsepower to fit both gasoline- or Diesel-powered engines, more than likely you, too, can gain the many moneysaving benefits of this drive. The completely *self-contained* converters are compact, easy to install and surprisingly low in price.

Check your equipment manufacturer or dealer or write us for full particulars.

ALLISON DIVISION OF GENERAL MOTORS
Box 894W, Indianapolis 6, Indiana



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TORQMATIC DRIVES

GUIDE WORDS FOR TODAY

"STOP THE MARCH OF CONQUEST!"

says the Honorable

William F. Knowland

U. S. Senator from California

"Communist talk of coexistence," says Senator Knowland, "is designed to lull the free world to sleep until Russia's nuclear war potential equals that of the U. S. This will happen some time between 1957 and 1960. The Communists will then resume their march of conquest. They will nibble away at the free world, which will be too frightened to resist. Finally the U. S. will become an isolated patch of democracy — a continental Dienbienphu in a Communist totalitarian world."

• • •

Communist purpose has never deviated. Only Communist tactics change. When time is needed to recover from a loss or to prepare new moves, they ask for a "truce," or they talk "cooperation," or they ask for "coexistence." Communism tries to "lull the free world to sleep." We must guard ourselves against these things if our freedom is to survive.

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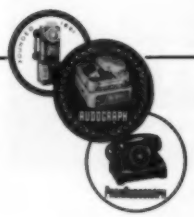

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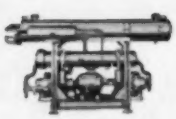
ROOM AIR CONDITIONERS. *Conventional Window Models* in ½-, ¾- and 1-hp capacities. Ideal for home or office use. Reverse-cycle operation of Custom models provides heat for chilly days. *Casement Window Models* in ½- and ¾-hp. Easy inside installation without cutting or removing glass—nothing projects outside.

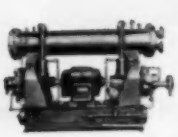
WATERLESS "PACKAGED" AIR CONDITIONERS. In 2-, 3-, 5- and 7½-hp. Use no water, need no plumbing—all-electric operation. "Packaged" model shown is complete with condenser and coil. "Custom" unit with condenser for outdoor or indoor installation.

WATER-COOLED "PACKAGED" AIR CONDITIONERS. 2-, 3-, 5-, 8-, 11- and 15-ton capacities. Cool, dehumidify, filter and circulate air. Free air discharge or duct distribution. Heating coil optional. Compact, space-saving design.

INDIVIDUAL ROOM AIR CONDITIONING UNITS. Used for year 'round heating and cooling by connecting to circulating cold and hot water system. Ideal for hotels, motels, offices. Three types—floor, wall and ceiling. Built-in controls. Two centrifugal fans provide circulation.



"PACKAGED" LIQUID COOLERS. Supply chilled water for refrigerated cooling in central system air conditioning of buildings of all types. For use with Freon 12, sizes 3- to 75-hp. For use with Freon 22, sizes 25- to 125-hp. A completely assembled unit—piped, pressure tested, dehydrated and supplied with a refrigerant holding charge.

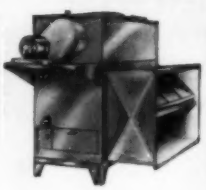


RADIAL COMPRESSOR UNITS. In 10- to 125-hp capacities, these heavy-duty units for use with Freon are especially designed for air conditioning or refrigeration. Radial compressors are direct connected and have force-feed lubrication. Automatic capacity-reduction. Light weight, economical to operate.

CENTRAL PLANT "PACKAGED" AIR CONDITIONERS. Self-contained Central Type "Packaged" Air Conditioners of 25-, 40-, 60- and 100-ton capacities. Utilize the Airtemp Radial Compressor with its exclusive features. Available with evaporative condenser or for use with cooling tower.

EVAPORATIVE CONDENSERS. In sizes from 3- to 100-hp, for either indoor or outdoor application in central type air conditioning systems. Perform function similar to that of water-cooled condenser and cooling tower combination. Sectional construction. Protected inside and out against damaging corrosion.

AIR HANDLING UNITS. These unit air conditioners, in floor and ceiling types, are available in capacities from 1.5-hp to 175-hp for handling air in volumes from 480 to 37,000 cfm. Designed to cool, dehumidify, heat, humidify, filter and circulate air.



COOLING TOWERS. In capacities from 3- to 100-hp. Designed to save up to 95% of the normal water requirement for all types of air conditioning equipment from the simple "packaged" air conditioner to the large central plant system. Adaptable for outdoor use.

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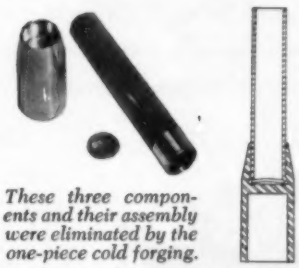
HUNTER DOUGLAS ONE-PIECE COLD FORGINGS

replace 3 piece unit, eliminate assembly, solve gas leakage problems!

A typical example of how Hunter Douglas cold forgings simplify everyday design problems

A most critical requirement in the production of an ordnance component was a perfect seal against the escape of high pressure gases. Fabrication by conventional procedures involved the assembly of three separate pieces—a screw machine part turned from bar stock and bored from each end; a separate sleeve machined from tubing, and a stamped Welsh plug. The three parts were unitized by expanding the Welsh plug within the sleeve, forcing walls into a machined groove within the head.



These three components and their assembly were eliminated by the one-piece cold forging.

To simplify the design, insure leak-proof construction and eliminate costly machining and assembly time, Hunter Douglas engineers suggested a cold forging from HD-11-T6, a high strength aluminum alloy.

All internal and external diameters of the cold forged component are now formed in a single, instantaneous press operation. No joints exist to cause leakage, consequently rejects are negligible. The cold forging, being highly stressed, easily withstands bursting pressures of 5500 psi without distortion. With its remarkable simplification in design, the cold forging requires fewer machining operations, thus saving both time and unnecessary metal waste.

Hunter Douglas Cold Forgings can be mass-produced in any required numbers and to cover a 'remendous range of design' requirements. If your components require *walls of zero draft, high physical properties, employ tubular shapes with or without a closed end, and must meet close dimensional tolerances,* HUNTER DOUGLAS COLD FORGINGS may provide the answer. Our engineers will give you a prompt analysis upon submission of a blueprint or sample part.

Hunter Douglas Cold Forgings cover a multitude of needs. Note wide variation in part geometry. Many complex designs formerly considered impossible to produce by cold forging now respond to new techniques developed at Hunter Douglas.

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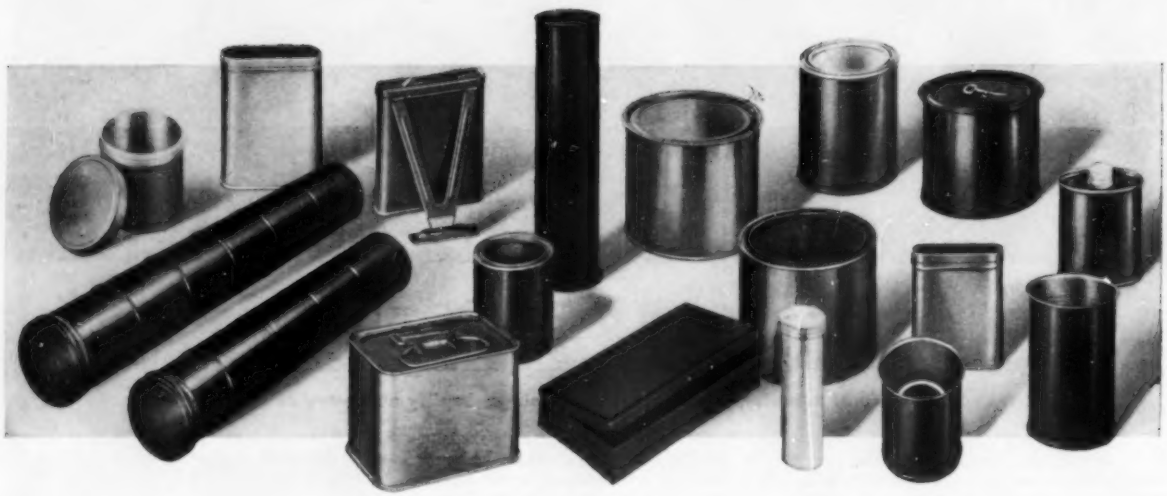

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Gun part: A flanged bushing with internal splines. Time calculated to make by machining was two hours; by powder metal 30 seconds. The Stokes press actually delivers 10 per minute. It took only 6 weeks to start production in powder metal; 11 months was estimated to make broach for machining.

Knurled gun sight: Iron, manganese and graphite powders are used in making this part at a rate of 1200 per hour. Sintering converts the metals to alloy steel.

Trigger member requiring upwards of 20 operations if machined is made at a single stroke on Stokes Powder Metal presses at the rate of several hundred per hour.

Bofors gun part: This piece is virtually impossible to machine because of the blind-end grooves on the sides. It is made of powdered iron on Stokes presses at 1200 per hour.

Gun part of unusual contours is made at hundreds per hour on Stokes Powder Metal presses. The simplest machine techniques to produce the part would require 11 machining operations.

Fuse assembly: 18 separate operations of assembly and gaging on a Stokes Automatic Ordnance machine complete this piece at the rate of several thousand per hour.

Brass rotor for artillery shell booster: Made on Stokes powder metal presses at 1000 per hour, and savings of 70% as compared with cost by machining.

Stokes Powder Metal Presses bring Automation to the Making of many Ordnance Parts

Stokes fully automatic equipment serves Ordnance Plants in the following ways:

(1) Making metal parts automatically . . . of copper, iron, steel, brass and other alloy powders . . .

(2) Consolidating pellets and charges for many types of artillery . . .

(3) Assembling ordnance parts . . . often with as many as 18 separate but automatic operations on a single piece.

Typical metal parts automatically made at high speed are shown in adjacent illustrations with comparisons of what is required to machine them from solid metal.

Stokes automatic assembly machines combine automation with safety and a high degree of adaptability for changeover to varying requirements.

The experienced counsel of Stokes experts on Powder Metal and Automatic Ordnance Loading and Assembly equipment is available to you on request.

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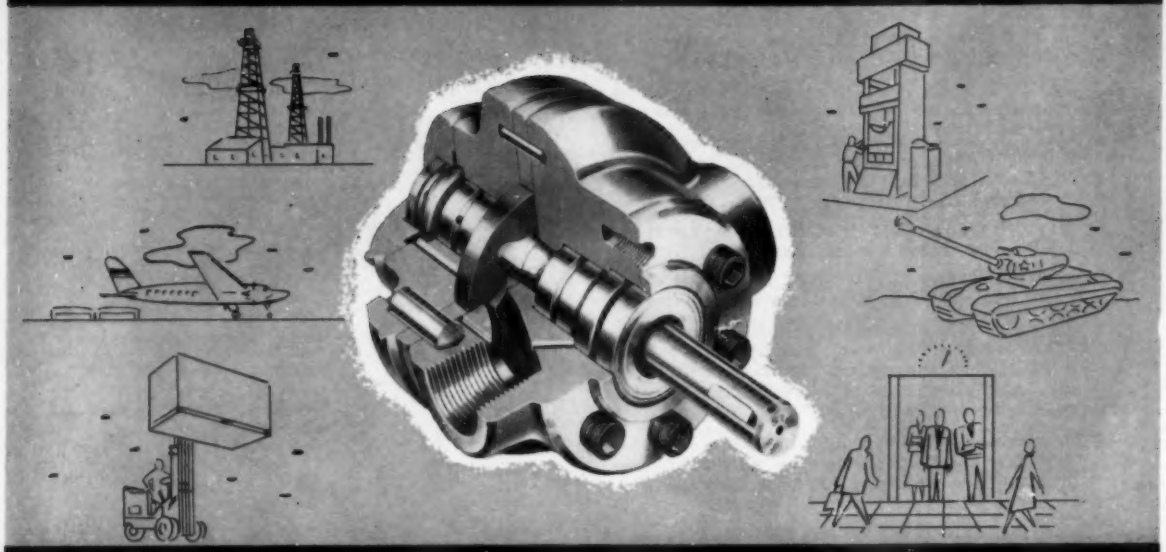

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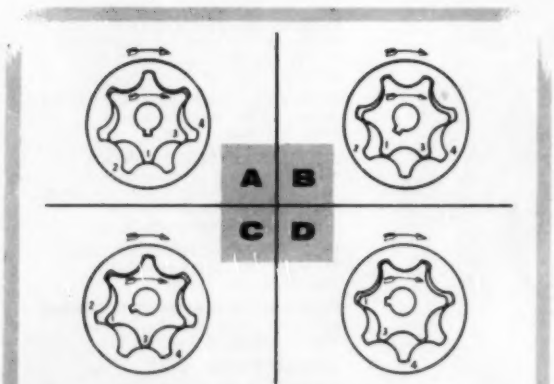
Gerotor's simple design and sturdy construction assures longer, trouble-free life for your hydraulic system!



The two Gerotors revolve at different speeds, resulting in a continuous opening and closing of the spaces as shown in this diagram. Follow the changing position of tooth #1 as rotation takes place. Note its relation to space #2. As rotation continues, tooth #1 gradually displaces oil from space #2, thus creating pressure. The outer rotor of the Gerotor principle is designed with one tooth more than the inner rotor, with fluid-tight contact at all points. As a result, low tooth sliding velocity is achieved.

Friction is the basis for all wear . . . Gerotor's exclusive rotor design cuts friction to a minimum. The Gerotor principle . . . heart of every Gerotor pump . . . is represented by a pair of gear-shaped elements, one within the other. Power is applied through the shaft to the inner Gerotor and is transmitted in the closed mesh region to the outer Gerotor.

Each tooth of the inner Gerotor is in sliding contact with the outer Gerotor at all times, providing continuous fluid-tight engagement at very low contact speed. The contact points revolve only once in seven to nine revolutions, depending on the type of unit. ***This reduced friction permits higher shaft speeds, assures longer life.***

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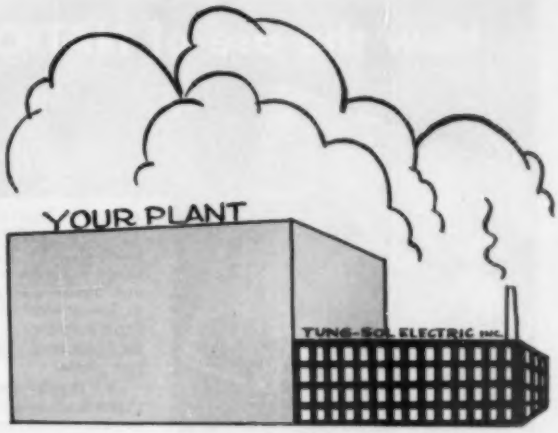

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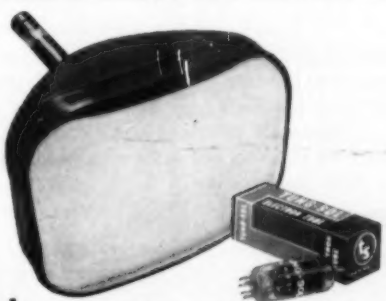

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How the use of NATIONAL Seamless EXTRUDED Stainless Tubing

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All machining on the nuts, except threading and O.D. finishing, is done in one operation on a 6-spindle, 3½ inch Conomatic automatic machine. A saving of five seconds in the time cycle was made by using the extruded hexagonal stock versus bar stock. The use of hex tubing has eliminated the cost and upkeep of boring tools—and, because tubing is considerably lighter than bar stock, it can be handled faster and with less difficulty.

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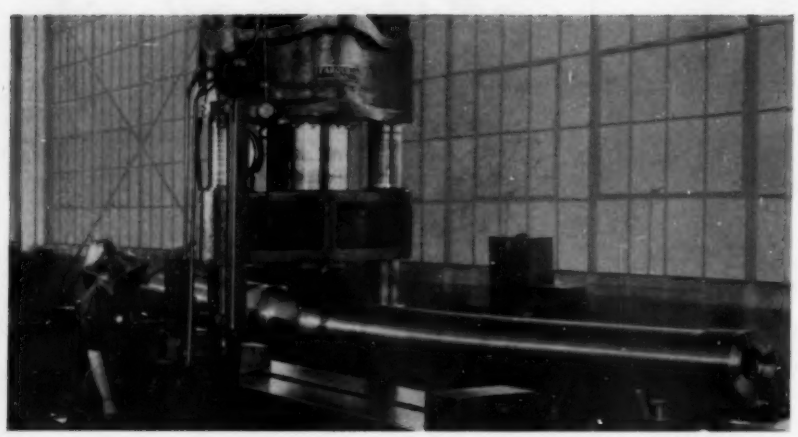
UNITED STATES STEEL



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This brochure was originally prepared as a special report and was mailed to all Company Members of the A.O.A. in February. It is now available without charge to all members upon request to the Editorial Offices.

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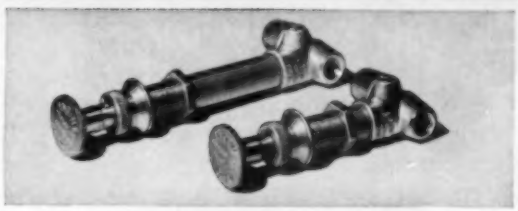

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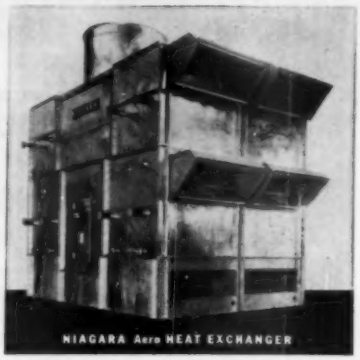

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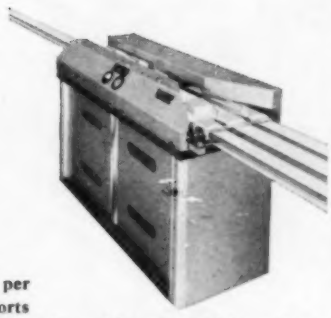

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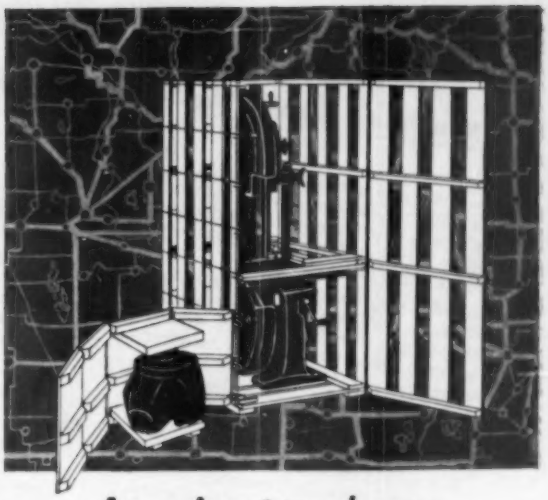

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Air Force Armament

Technical Advisory Group Helps To Develop Superior Weapons

Henry C. Maulshagen

Executive Director, Technical Advisory Group, Air Force Armament Center, Eglin Air Force Base, Fla.

THE Air Research and Development Command is charged with insuring qualitative superiority for the United States Air Force. The Air Force Armament Center, located at Eglin Air Force Base, Fla., was established under the jurisdiction of this new Command in 1951 as one of the chief agencies in the armament-evaluation program of the Air Force.

The value of the Armament Center has been established chiefly in these areas:

1. It furnishes engineering test results to aid the armament contractors in the development of airborne armament items and systems.

2. It recommends modifications of equipment during the development testing phases which will insure the reliability and effectiveness of the production models.

3. It provides the Air Force with factual engineering information on which to base the selection or rejection of an armament item.

Shortly after assuming command of the Air Force Armament Center in December 1951, it became obvious to Brig. Gen. Edward P. Mechling that an advisory group consisting of highly experienced men in the armament and instrumentation fields was an essential supplement to the Center. The complexity, technical level, and importance of adequate engineering evaluation of armament would require consultation with the best minds from industry and science.

Accordingly, in April 1952 General Mechling established a Technical Advisory Group at the Air Force Armament Center. The members of the group are among the leaders in the various technical fields associated with airborne armament testing. A full-time executive director is employed to maintain a continuous working relationship between the Advisory Group and the Center commander.

THE entire group convenes at the Center at least once a year to advise on the modification or extension of testing facilities and organization.

The problems associated with the development and application of armament-testing instrumentation receive detailed study on a continuing basis. The members of the Advisory Group present their recommendations on specific technical proposals regarding testing facilities and instrumentation. In addition, they give advice on the interpretation of test data and the validity of conclusions.

Consultation between General Mechling or Center engineers and members of the group is continuous throughout

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Quality production is necessary

the year. The advice and recommendations of individual members, closely associated with the special aspects of development and design of aircraft armament, are always available for sound engineering evaluations.

Since the group was formed in the early days of the Armament Center, most of the facilities and instrumentation has been procured with the benefit of their advice.

THE first meeting of the Technical Advisory Group was held at the Armament Center in June 1952. The enthusiasm and new outlook which these outstanding men brought with them were an inspiration to the Center. There have now been three annual meetings of the entire group and many additional committee meetings on special problems at the Center. Members have offered occasional seminars and lectures on pertinent aspects of armament testing.

The Technical Advisory Group is made up of five evaluation and instrumentation committees, each concerned with one of the primary functional responsibilities of the Armament Center. These are the Air-to-Air, Air-to-Ground, Bombing Systems, Chemical Munition, and the Ground Evaluation and Instrumentation Committees.

The Air-to-Air Evaluation and Instrumentation Committee has provided guidance in the planning of an air-to-air range for the engineering evaluation of fighter, interceptor, and bomber defense fire-control systems. This range occupies an area of 12,000 square miles and is located over the Gulf of Mexico south of Eglin Air Force Base.

GROUND-BASED radars are installed along the coastline to vector attacking aircraft and airborne tow targets or target drones into proper position prior to a test attack. The radars also will provide safety surveillance of the area.

The relative time-space position of the target, attacking aircraft, and missiles must be obtained with utmost precision. At the present time this can be accomplished only by means of complex airborne photo-optical instrumentation. The reduction of data collected in this manner is so tedious, time-consuming, and costly that each test mission requires a major effort.

The advanced instrumentation development program for the air-to-air range incorporates the philosophy that all test data should be recorded in a form suitable for electronic digital computation techniques. This program has received encouragement and assistance from the Technical Advisory Group.

Instrumentation to obtain time-space-position data is now under contract for development. It will use airborne applications of infrared and visible-light tracking techniques for angular measurements, phase comparison radar methods for determining distances, and inertial sensing instrumentation.

The Air-to-Air Committee also has provided design approaches for the improvement of a firing-error indicator mounted in an airborne target. The indicator will provide the vector distance by which a missile misses the target.

A promising recommendation of the Technical Advisory Group has resulted in the beginning of a long-range program for the development of both airborne and ground-based simulators for use in the evaluation of airborne fire-control systems. The thorny technical problems of conducting tests of fire-control systems under air-to-air conditions will be attacked by a coördinated test program, combining simulated and actual flight conditions.

IN this way it will be possible to provide a test environment with a high degree of control for the isolation of system errors followed by a relatively brief period of flight testing.

The Air-to-Ground Evaluation and Instrumentation Committee has been concerned primarily with the instrumentation necessary to evaluate dive-bombing and toss-bombing systems and the air-to-ground gun and rocket modes of fire-control systems.

The methods now being used for determining time-space position, the attitude of the approaching aircraft, the necessary meteorological data, and other parameters has followed closely the procedures so excellently developed during the past years at the Naval Ordnance Test Station at Inyokern, Calif. The photographs from numerous fixed cameras, stationed on the ground at the target center and along the flight line of the entering aircraft, are used to determine its time-space position.

Airborne cameras record tracking error and enough photogrammetric data to establish the attitude of the aircraft. The correlation and data-reduction problems associated with this method of determining test parameters are, however, enormous.

The Air-to-Ground Committee has given valuable suggestions on more convenient methods of boresighting the ground cameras, and one member of the group is actively formulating a technique which will eliminate the necessity of using photogrammetry for determining attitude.

Instrumentation-development contracts have been initiated which, if successful, would eliminate to a great extent the present dependence on photographic data-recording techniques.

IN the first conference, this committee was able to make an immediate contribution to the early organization of the new Center. It was recommended that serious attention be given to design-of-experiment analysis to insure selection of the most efficient sets of test conditions and to define limiting accuracy requirements of the instrumentation.

As a result of this timely suggestion the function of the Office of Analysis and Reports was broadened to include a member of this office on the project team for each test project. Using mathematical procedures, the project analyst attempts to establish a method of obtaining the desired result with a minimum of costly test missions and procedures. Additional experienced analysts are being employed, and more are needed to cope with this broadened function.

ALL the primary facilities at the Armament Center for the evaluation of "straight and level" bombing systems and instrumentation for determining bomb characteristics are within several months of completion. Six Askania phototheodolites for determining the time-space position of both the bomber and the released bomb are in operation on the precision bombing range. The photogrammetric range for precisely establishing the space position and attitude of an aircraft has been completed. Land and water impact and pattern bombing ranges are now being instrumented with the new Contraves phototheodolites.

The Bombing Systems Evaluation Committee has given suggestions and encouragement on the design and construction of a synthetic radar range for the evaluation of the information content in the presentation of a bombing system radar. Very helpful advice is being given toward improving known techniques for the evaluation of the new inertial bombing systems.

A plan to use the ground radar of the Nike system for establishing the time-space position of test aircraft has been endorsed by the members of the group. This will enable the Armament Center to exploit a system that is already in production. The use of this modern and fully developed system will save the Government a substantial amount of money and precious time.

THE Ground Evaluation and Instrumentation Committee has been active in providing sound advice on gun- and rocket-testing techniques and associated instrumentation-development programs. A static gun-testing facility has been in use at the Center for a year in the gun-evaluation program of the Air Force. An inclined track for launching rockets at aircraft speeds to determine their in-flight characteristics is now complete. Construction will soon begin on a damage-potential range to ascertain specific aspects of rocket and gun projectile terminal ballistics.

The members of the Advisory Group who are specialists in this field have critically analyzed the majority of the instrumentation procurement and development plans for the ground testing facilities.

They have provided specific suggestions on the majority of items such as a Doppler muzzle-velocity chronograph, an aircraft turret test facility, and gun gas analysis equipment.

The practicability of the Center's programmed construction of a universal firing gun stand for simulating the interaction between gun and aircraft was declared questionable. Advisory Group members are prepared to offer critical comment as well as encouragement.

The Chemical Munition Instrumentation Committee has convened at the Center many times between annual meetings. This committee has been exceptionally active in providing continued consultation on Center problems in this field.

Members of the 23-man Technical Advisory Group examine the time-signal generator at Eglin Air Force Base during the committee's annual meeting (Air Force photo).

The first meeting of the Technical Advisory Group in 1952 emphasized that although the completion of the basic testing facilities at the Armament Center was still two years off, study and planning should begin immediately for the application of new techniques to future armament testing. Advanced armament test instruments and instrumentation systems will be necessary to pace the rapid development of coming Air Force weapons.

In November 1952 General Mechling assembled several individuals from the Center with high skill and long experience for the nucleus of an Armament Test Equipment Laboratory. This new organization proceeded with the planning and initiation of contracts to commercial and educational organizations for the development of advanced test instrumentation. At present the laboratory is monitoring and guiding seventy development contracts and as a consequence draws heavily on the services of the Advisory Group.

The consultative help furnished by the members of the Technical Advisory Group has been vital in the planning and operation of the Center. The members are to be highly commended for the time and effort they have given so loyally to the Air Force and their country. This close association of a Government testing organization with the best minds in industry, education, and science is a real contribution to the cause of quality in aërial weapons.

A meeting of the Range Instrumentation Committee discusses AFAC facilities.

New Electronic Brain

The NORC receives problem instructions at a rate of 70,000 decimal digits a second, recalls "memory" data in 8 micro-seconds, and can perform 15,000 complete calculations a second

IT is now "practical and feasible" to forecast the weather for an entire hemisphere thirty or sixty days ahead by calculations occupying perhaps twenty-four hours, with results about as good as those obtained by an experienced subjective weather forecaster.

Calculations similar to those now made, forecasting weather over the area of the United States for twenty-four hours in advance, could be made in perhaps half a minute by the Naval Ordnance Research Calculator (the "NORC") recently built at the Watson Laboratory of Columbia University by International Business Machines Corporation for the Navy Bureau of Ordnance.

Nor is this the extent of the NORC's capabilities. Considered the fastest and largest-capacity calculator in existence, the new electronic "brain" can make complete calculation of the tidal motions of all the oceans, including the marginal movements near the continents as well as the main motions of the oceans, in a matter of days.

Calculation of the hydrodynamics of the earth's fluid core, the movements of which are responsible for the main phenomena of terrestrial magnetism, probably will become accessible for the first time with the NORC.

In the statistical field, dealing with matters which are not wholly mechanical—such as troop and logistic operations involving purely accidental factors like the prevailing weather during the operation—command decisions which have not yet been officially made can be stipulated to the NORC and various solutions for various alternatives calculated. This has been done before on a minor scale, but it always has taken too long to do on a large scale.

IN a recent test the NORC ran for four hours without an error, doing in this period more work than any previous calculator is believed to have performed in its entire lifetime.

Developments that led to production of the NORC began as a research project in 1946 when IBM sought to perfect electronic computing devices that would count accurately at the rate of a million times a second.

The results were so impressive that in 1951 the Navy Bureau of Ordnance, having a growing need for a calculator of greater capacity, contracted with IBM to build these components into

The NORC's operating console and logical and arithmetical section are shown in the background, printers in foreground.

an electronic computer of the highest performance standards.

The need for such a machine was emphasized by the fact that existing giant "brains," despite their fantastic speed, were still too slow to solve within practicable time limits many problems of interest to defense that otherwise would have to be tackled by costly experimental methods.

FOR example, one such puzzler involving many billions by computations, is known as the "cavitation problem." This involves the size and shape of a cavity or envelope of comparatively empty space that forms around an object moving under water.

In the case of an underwater weapon, if the cavity were so big that fin and rudder surfaces did not touch the water, control would be lost or impaired and the target possibly missed. If the cavity is small enough so that steering surfaces engage the water, control is maintained.

The mathematics of the cavitation problem have been known, but the solution was beyond the practical capacity of existing computers. NORC is expected to obtain solutions within reasonable time limits.

Problems of similar magnitude exist in connection with other ordnance developments and in many problems in pure science, the solution of which are in the national interest. In fact, in the process of testing NORC, problems of interest to the Navy and problems in basic science of particular interest to Columbia University physicists have been undertaken successfully.

NORC substantially exceeds its design specifications in speed, carrying out 15,000 complete arithmetic calculations a second. Each of these operations themselves involves several steps —obtaining the specified numbers from input or storage (memory), performing the calculations, placing the decimal point, checking the answer, and storing the result as directed. To obtain the same results in some earlier machines has involved the execution of as many as thirty separate instructions.

Input of the new machine is by magnetic tapes which are loaded from cards punched on separate equipment. The magnetic-tape units, of which there are eight, were specially designed and built for NORC by IBM's Poughkeepsie engineering laboratory. They provide an unprecedented flow of numerical data into the machine and permit the solution of extremely large computations.

MORE than five times faster than the fastest magnetic tape units in current use, these tape units bring data into the electronic calculator at the rate of 70,000 decimal digits a second. So effective are these devices that they are used not only for all input and output of the machine but also for any large-scale storage of intermediate results during the calculation.

Numbers stored in the calculator's cathode-ray-tube memory can be recalled from any one of 2,000 locations in 8 microseconds—8 millionths of a second.

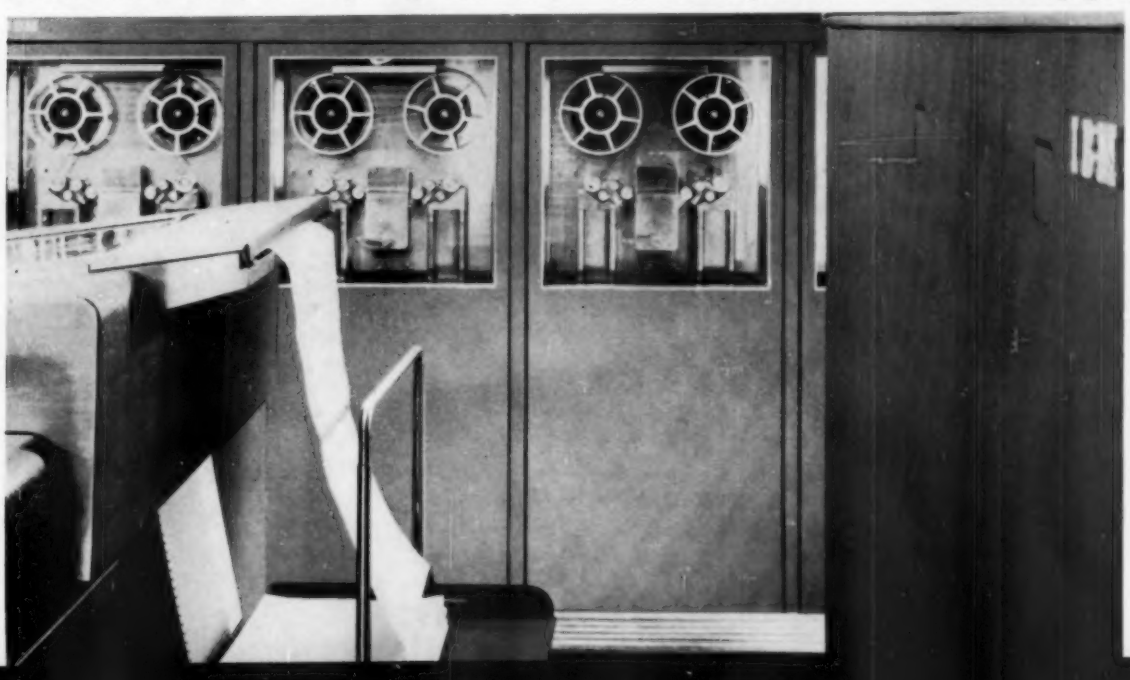
This machine performs its arithmetic just as a person does—a digit at a time, but much faster; for example, addition and subtraction of 13-digit numbers in 15 microseconds or multiplication of numbers of similar size in 31 microseconds. In the process of addition and subtraction, a digit is added or subtracted each millionth of a second, and in multiplication a digit of the product is produced each microsecond—the entire 26-digit product being formed in 26 microseconds of the 31-microsecond multiplying time.

IN other words, NORC can produce the answer for addition, subtraction, or multiplication as fast as it can read the numbers—one million digits a second! But these speeds are needed to solve practical problems in present-day research, some requiring as many as ten thousand million operations.

Many novel engineering features are incorporated in NORC. The printers, which enable the scientists to follow the calculation, are so arranged that calculation continues during printing, and the speed of calculation is reduced less than three per cent while the printers are in operation.

NORC was moved recently to the Naval Proving Ground, Dahlgren, Va., where it was installed in the Computation Laboratory which already possesses other computing machines. It is expected that this installation will provide one of the most versatile computing facilities in existence.

Problem instructions are read from magnetic tape units in background; printer in foreground records NORC's calculation progress.



Challenge in Korea

The mission of an ordnance adviser assigned to the ROKA is one of instruction, coöperation, good will, and patience to help Korean troops operate and maintain American equipment

Maj. Reynold A. Atlas

LIFE as an ordnance adviser to a Republic of Korea Army division during combat was certainly frustrating, ulcerous, strenuous, and nerve-wracking—but vital to the war effort. This was the type of duty that the word "challenge" was designed for. Of course, the problems there were no worse than with any similar group in any other country; only intensified due to the stress and requirements of combat.

Many of the problems were the same as in any American unit. For example, a perennial problem in every U. S. Army motor pool is maintaining the correct tire pressure on trucks. The same problem exists in the ROK Army. One spot check in a ROKA unit showed that thirty per cent of the tires had pressures of five pounds or more below the standard pressure. This is just about the same discrepancy as in any American unit. However, the correction of this in a Korean unit is much more of a problem.

A different type of problem arises from bad training. The Koreans were taught by the Japanese that when a battery was low on electrolyte, acid should be added and water should never be added. Constant supervision was necessary to change this habit; but not before thousands of batteries were ruined.

Another problem with the ROKA is communication. Very few Korean soldiers speak any English, so that all discussion must funnel through one tight bottleneck called an interpreter. Facts could be interpreted fairly well, but ideas were difficult and often impossible to put over.

Besides, a low-ranking interpreter will change his interpretation depending on the higher rank of the Korean officer he is talking to. The language problem prevents complete liaison and coöperation and somewhat isolates us from what is actually going on.

Local customs are always a problem. "Saving face" is a characteristic throughout the Orient, and something that we must live with. As a result, the Koreans are reluctant to ask questions because they feel that it shows ignorance on their part. Thus, it is necessary to take the initiative and point out things without sitting back and waiting for questions.

When a point is explained they usually nod assent and agree with everything, thus apparently showing understanding of the explanation. Not to agree would show that they were not smart enough to understand us. It is rare for them to admit that they do not understand. Besides, they wish to get along with us and feel that they should agree, even when they have no idea what we are talking about.

Major Atlas is currently serving in the Far East as an Ordnance adviser to divisions of the Repubic of Korea.

The mission of an ordnance adviser to the ROK Army is just that—to advise on all ordnance matters and improve its ordnance effectiveness. We have no direct authority. If they do not accept our advice or do not wish it at all, there is little that can be done except at a higher level with a major case.

Our authority stems primarily from coöperation, good will, and proving that our advice is sound and for their best interests. A secondary source of our authority is in approving requisitions for U. S. equipment. Once issued, however, we have no authority in its use.

AN example of our assistance occurred during an ordnance inspection of a regiment in reserve. It was noted that there were very few magazines for BAR's. In answer to questions, they commented on how the shortage of magazines was hurting them in combat. Without enough magazines they lost time reloading magazines during an action. They were surprised to find out that Standard Nomenclature List A-4 authorized nineteen magazines per BAR. With assistance, the magazines were requisitioned and shortly received.

In accomplishing his job, the ordnance adviser does not need any special techniques or fancy procedures. It is only necessary to apply existing regulations and procedures. There is ample information in our present manuals. It is only necessary to use it. We must, however, work at a lower level and more on fundamentals and basic prin-

ciples than with an American unit. The Korean soldiers are not as experienced as ours, so that simplicity is essential.

The most important ordnance activity in the division is unit maintenance, because there is the most profitable place for improvement. More benefit comes from concentrating on one hundred trucks deadlined in unit motor pools than in ten deadlined in an ordnance maintenance company.

AS important as staff planning and high-level ordnance activity is, nothing is accomplished until commanders and advisers supervise and train the people in the field so that plans can be carried out.

It is a constant source of amazement how much material can be poured into a foreign army, like the Korean Army, and not be available for use by the man on the ground—how many grandiose plans can be made but not carried out effectively, or at least not effectively by our standards. A motor pool looks beautiful for inspection with its trucks painted, shined, and lined up with a transit.

But what happens when the unit must move fifty miles?

How many trucks go into a ditch because of poor drivers? How many arrive five days later because of breakdowns? How many wrecks are due to no brakes? It looks good to make plans in a headquarters or in Washington, but of what use are they if not carried out? We easily issue a hundred trucks because we know that they are needed; but are they used effectively? Not always.

Like anything else, ordnance service must have active command interest and support to do any good. Higher commanders are always in favor of it in principle, but until they actively push it, the lower commanders will drag their feet.

AS an example, the maintenance in one regiment was particularly poor, and no amount of effort would improve it. However, when the commanding general was sold on ordnance and this particular poor maintenance was pointed out to him with specific examples, then things happened.

With a large sum of money from the regimental fund they bought parts, paint, and everything else on the black market in order to repair their ordnance equipment. Some trucks were repaired in civilian garages. In two weeks of fifteen-hour workdays, their equipment compared well with that in any American unit.

Supply, of course, is the basis of maintenance and planning. As usual, poor maintenance was blamed on lack of supplies. Although the availability was low and supplies short, much more could have been done with what was on hand.

For example, an inspection of one motor pool of sixteen trucks showed that the primary deficiency was that fifteen trucks required general tightening. This was typical of all motor pools, indicating that the primary requirement was not supplies, not tools—just training and supervision.

THE main reason for the scarcity of parts was not any theater shortage but failure to requisition them. Why? First, the Korean soldier is brought up conditioned to having nothing and asking less.

Secondly, all our Ordnance catalogs do him little good since he cannot read or write English. Every unit had stacks of brand-new publications which were of no use. The supply of catalogs is wasted when they cannot be read, but what is worse is that the vital information in the catalogs and manuals is not available to the troops.

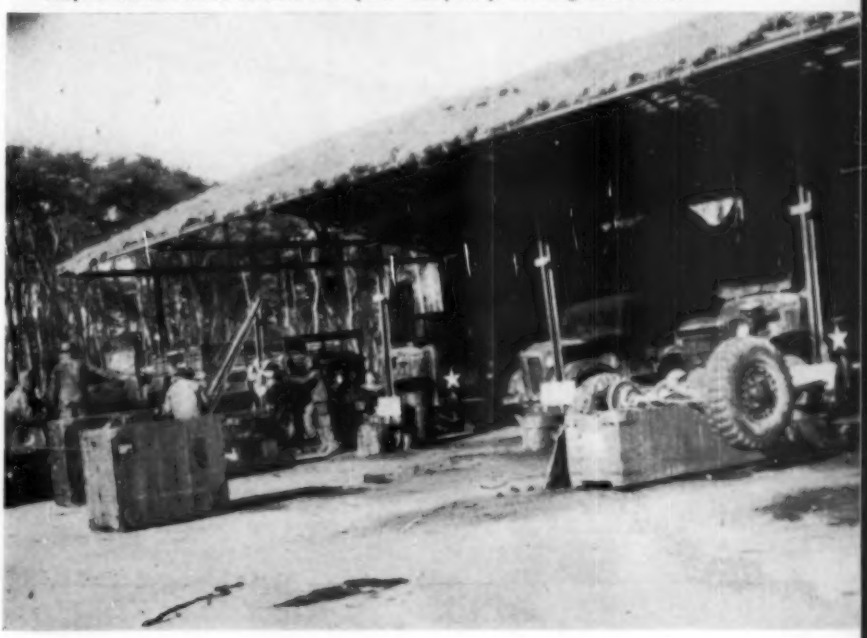
There are many amazing examples. One division used only bore cleaner to oil its weapons—from somewhere they had gotten this stock number. There was no rifle oil in the division because they could not read the SNL or field manual to know that it existed.

When hub bolts on a truck brake drum broke, they were not replaced because no one could find the stock number in the SNL. As a result, many wheels had only three or four lug bolts holding them on instead of six.

ALL twelve 4.2-inch mortars in the heavy mortar company looked good and would fire—after a fashion. Two were not safe and two more were inaccurate and could not hit a target. The reason? No spare parts had been received by this company for the past year, except for a few they managed to scrounge from American mortar companies, because no one could read the manuals to requisition them. This matériel was typical of all units.

The situation on tools was the same with many shortages of special tools. Shortages were just a good excuse, however. Tools are not required to put water in a battery, and no amount of

A bombed-out railroad supplied the steel framework for this maintenance shop in Korea. Native soldiers were particularly adept at using local material.



tools do any good in a stock room instead of in the hands of the mechanics. In other words, tools do not maintain trucks—men do.

An inspection of a field-artillery battalion headquarters motor pool revealed the following in their original packing 6 months after receipt: 9 empty tool boxes, 8 socket wrench sets, 11 eight-inch adjustable wrenches, 1 paint spray gun, 2 carpenter saws, 3 power grease guns.

In spite of this excess, many units fight for every tool, piece of equipment, and part they can lay their hands on because a full stock room "looks good" for the unit. Requisitioning is based as much on authorization and availability as it is on need.

ONE reason for all this excess equipment in the midst of shortages is that the U. S. Army tool sets—like much of our equipment and organization—are too complete, extensive, and complicated for troops not as well trained as our men. We must remember that our equipment was designed for use by Americans.

Vast amounts of our equipment have been supplied to many nationalities in World War II, the Korean War, and through the Military Defense Assistance Program, and more will be supplied in the future to our allies. Therefore, simplification of the amount, types of equipment, and accessories, such as tools and parts, would save much money. Tables of equipment, organization, tool sets, and parts allowances all should be decreased and simplified for allied countries as necessary.

"In accomplishing his job, the ordnance adviser does not need any special techniques or fancy procedures . . . It is only necessary to apply existing regulations and procedures . . . We must, however, work at a lower level and more on fundamentals and basic principles than with an American unit. The Korean soldiers are not as experienced as ours, so simplicity is essential."

Our American solution to problems is too often the use of mass. Pour in enough matériel and enough will be used to accomplish the job, even though a low percentage. This method works, as long as funds and supplies last.

As regiments came off the line, all weapons and equipment were given a complete inspection and repaired immediately with the assistance of American Ordnanceemen.

More than the possession of equipment is required to make a modern Army. If all equipment on hand were in use and used properly, a minimum of equipment would be required. Just having it, however, does not mean that it is being used properly. As a result, we must furnish much excess and duplicate equipment because so much is not utilized.

Commanders of Korean units were shown a few simple PM (preventive-maintenance) indicators with which to check their units. If only these elementary things were done, the largest share of improving maintenance could be accomplished. These are some of the PM indicators on trucks:

1. Turn on all truck lights. On an average, only fifty per cent of headlights worked.

2. Check for the number of trucks on deadline and why.

3. Check for battery water level. As simple as this is, more batteries were lost due to low water than any other cause.

4. Push the brake pedal down with a finger to determine free play. A surprisingly large number have no brakes at all.

5. Look in out-of-way places for unauthorized work. Some unit motor pools that would not do simple work, like adjustment of free play on a steering wheel, would perform difficult higher-echelon work like replacement of engine bearings.

We know the capabilities of our own units, but often we overrate the capabilities of allied units. Sometimes we see only how far our training has brought them, without seeing how much farther they must go to meet our standards. Therefore, logistical plans must reflect their actual capabilities, not what they should be.

There is never enough time to train a division completely, and even two years of the worst combat in Korea does not finish the necessary training. It is certainly more pleasant for a driver to sleep in the back of his truck than to check tire pressure. Command supervision must insure that lessons learned are applied.

Many of these problems are common to our Army and to all wars, although in different degrees. The solution is always the same: training and command supervision.

Mechanical Time Fuzes

Continual effort is being made by the Ordnance Corps to develop and perfect the setting, tensioning, waterproofing, and the zeroing of these devices vital to the national defense

Gene Rove

IN 1860, Lieutenant Tremel, a Bavarian officer, developed what may be considered to be the first mechanical time fuze. It consisted essentially of a metal tube threaded at one end for assembly to the projectile and containing a quantity of lead balls and a bolt with a firing pin at one end.

The resultant forces of the motion of the projectile caused the lead balls to move away from the bolt. At the end of an elapsed time which depended upon the quantity and size of the lead balls and the speed of the projectile, the balls were removed from the path of the bolt and the firing-pin end of the bolt struck a primer causing projectile detonation.

Throughout the years that followed, continued advancements in fuze design and development were made in an effort to maintain pace with the development of new cannon and the requirements of our armies and those of other nations.

FOR a good many years now, mechanical time fuzes have been an indispensable item of our Ordnance ammunition, and every indication is that they will continue to be so for many years to come.

Essentially, the modern mechanical time fuze is a small, accurate clock, rugged and well protected so as to be able to withstand the tremendous setback forces and rotational velocities imparted by the weapon, and presettable so as to cause detonation of the projectile within the required time tolerance.

Actually, the design, development, and manufacture of mechanical time fuzes presents problems far different from those presented by any other Ordnance item and, indeed, unlike any civilian product.

Production of mechanical time fuzes by the Army Ordnance Corps has, for the past few years, been concentrated primarily on two models, the fuze, MTSQ, M500A1 and the fuze, MTSQ, M502A1. The M500A1 has a maximum time setting of 75 seconds and is essentially a field-artillery (land combat) fuze, while the M502A1 is a 30-second antiaircraft fuze.

Basically, however, the two fuzes are very similar, and this article will attempt to discuss the salient features of each.

Let us first examine the timing mechanism. When the fuze is set, either by an automatic fuze setter, a hand-type fuze setter, or by utilizing the graduations on the body, the upright portion of the firing arm is displaced from the firing notch of the timing disk by an angle corresponding to the set time.

Setback forces in the weapon cause the setback pin to deform the setback pin spring, and the pin is forced down into a clearance hole provided in the fuze body.

Rotational velocity imparted to the projectile by the weapon causes the safety lever, which is supported by a resisting spring, to slide outward, thus unlocking the escapement lever.

CENTRIFUGAL force also causes the centrifugal gear assembly to impart a torque to the center pinion. In the case of the M500A1 fuze, two torsion-type centrifugal springs are utilized to provide additional torque. These springs are not required in the M502A1 fuze, since the antiaircraft weapons impart a sufficiently high spin (a minimum of 16,000 revolutions a minute) to insure that sufficient torque is imparted to the center pinion by the centrifugal gear assembly to run the mechanism through its maximum time setting.

The torque imparted to the center pinion is transmitted by the gear train to an escapement. This escapement insures an almost uniform time rate regardless of input torque variations. And, as may be expected, there are input torque variations caused by such factors as spin decay, temperature variation, gun elevation, and tolerance variations within the fuze mechanism.

However, regardless of the driving torque, the center pinion will rotate through an angle of 337 degrees, 30 minutes, at the maximum fuze setting.

The center pinion is keyed to the timing disk, so that as the timing mech-

Mr. Rove is assistant chief of the Electromechanical Time Fuze Engineering Branch at Frankford Arsenal, Philadelphia, Pa.

anism runs, the timing disk will rotate. At the completion of the elapsed time for which the fuze has been set, the firing notch in the timing disk will be aligned with the upright of the firing arm, and the torque exerted by the firing arm shaft spring and the centrifugally actuated firing arm shaft weight will cause the firing arm upright to fall into this notch.

THIS causes alignment of the slot at the base of the firing arm and the firing pin safety plate, and a combination of the centrifugal force on the safety plate and the downward pressure exerted on the firing pin by the firing pin spring causes outward rotation of the firing pin safety plate sufficient to free the firing pin from the firing pin safety plate.

The firing pin strikes the M29A1 primer which detonates and causes detonation of the M7 relay.

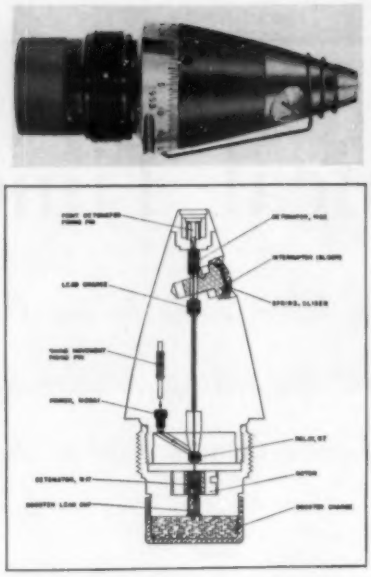
This relay is lead azide compressed at approximately 10,000 pounds per square inch in an aluminum cup, and its functioning will cause detonation of the M17 detonator. This detonator sets off the lead cup, which, in turn, detonates the tetryl booster charge. It is this booster charge which causes high-order detonation of the projectile.

As was previously mentioned, the timing mechanism must be sufficiently rugged to withstand high setback and rotational forces. Design considerations generally are 50,000 G's and 30,000 revolutions a minute.

ACCORDINGLY, the gear train and associated parts are protected by fitting them within a stack of brass and aluminum plates. Very accurately located holes in these plates serve as bearings for the pinion pivots.

The thickness of the various plates must be held to extremely close tolerances to insure sufficient end-shake to prevent binding, but not excessive end-shake, which would decrease timing accuracy.

An examination of an exploded view of the fuze shows how the timing mechanism, or movement as it is commonly known, sits in an aluminum body. The angular relationships between the movement, the graduations on the body and the setting notch of the body are accurately maintained by means of a steel locating pin pressed



Top, mechanical time fuze MTSQ, M500A1. Bottom, cutaway of the same fuze showing explosive train with labeled parts.

into the body. Three screws are utilized to attach the timing mechanism firmly to the body.

It is apparent that the permissible tolerances of the setting notch, the graduations, and the locating pin must be very small to insure small time dispersions at firing.

The lower cap assembly fits snugly around the movement and is attached to the body. A music-wire spring, known as the lock wire, is seated in a groove in the lower cap and rests on an angle machined on the body.

Four lock wire screws in the lower cap are tightened after the cap has been assembled to the body until the proper resisting torque (approximately ninety-five inch-pounds) has been applied. This torque is required to insure that the fuze can be readily set to the required time setting, but will not slip during shipping and handling.

LOCATED through the upper web of the lower cap is an eccentric pin known as the setting pin. During the assembly of the fuze, the adjusting line on the lower cap is exactly aligned with the zero line on the body. The eccentric pin, which engages through the slot in the timing-disk setting lug is rotated, rotating the timing disk until the firing arm upright is exactly at the drop-off point of the timing-disk firing notch. The setting pin is then prevented from further rotation by means of a set screw in the lower cap which is tightened against it.

Army mechanical time fuzes incorporate, as well as the timing feature, a point-detonation element which insures superquick functioning upon impact, should impact occur prior to the expiration of the set time.

Thus the Army mechanical time fuzes are really dual-purpose fuzes, since, when a fuze is set on "safe," it is strictly a point-detonation fuze, and can be used as such.

In order to insure that the quality of the fuzes manufactured by any contractor is in accordance with the safety and functional requirements of the Ordnance Corps and the Field Forces, tests are conducted on samples of each inspection lot drawn at random by the resident Ordnance inspector.

These fuzes are subjected to rigorous tests to simulate rough handling and shipping, waterproofness tests, drop tests, spin firing tests, and ballistic tests. These tests are far more severe than actual conditions liable to be encountered, and it is felt that the safety factor thus obtained does much toward insuring that the Field Forces have at their disposal a safe and satisfactory end item.

ALL ballistic testing is accomplished at either Jefferson Proving Ground, Madison, Ind., or Aberdeen Proving Ground, Aberdeen, Md. Samples selected are test-fired at the proving ground to insure compliance with the safety phase, the target phase, and the time-test phase of the specification.

The safety phase consists of firing fuzes assembled to high-explosive loaded shell set for approximately ten seconds in the 75-mm. T83 gun. This weapon imparts more spin and setback than normally may be expected to be encountered in service use.

The target phase consists of firing fuzes assembled to HE lots set on safe (S) against either wood or chipboard targets. Current data indicates a dud rate in this phase of less than one-half of one per cent, and this is deemed quite satisfactory.

A chronograph is used to determine fuze accuracy in the time-test phase. The Aberdeen slow-motion chronograph is used by the Development and Proof Services at Aberdeen Proving Ground to measure the time interval between the impulses transmitted by the

recoiling cannon at firing and a photoelectric cell activated by round detonation. It consists essentially of a 110-volt, 60-cycle synchronous motor driving a drum at the rate of one complete revolution every five seconds.

Directly in front of this rotating drum is located a movable arm on which there are three spark points. These spark points are connected to a network of coils, condensers, and resistors, so that a spark is made to jump from the points to the drum upon discharge of the condensers.

THE condensers are discharged by means of vacuum tubes which are fired either by the passage of an object through a coil or a pulse from the photoelectric cell.

The drum is so dimensioned that the circumference is exactly 500 millimeters. Since one revolution of the drum requires five seconds, it is necessary merely to remove the tape and measure the distance between the two spark points to determine the time of flight of the projectile. The Aberdeen chronograph will measure the time of flight of a mechanical time fuze with an accuracy of better than 0.01-second.

Mechanical time fuzes contain components made of a variety of materials including various compositions of steel and brass, aluminum bar stock, aluminum die casting, zinc die casting, paper, plastic, rubber, and explosive components containing primer mixture, black powder, lead azide, and tetryl. Among the various manufacturing techniques employed are screw machine, forging, die casting, molding, punch-press work, and much automatic work.

OBVIOUSLY, the number of contractors capable of performing all the necessary production of component parts economically is very small. Accordingly, the Ordnance Ammunition Center, which is the procuring agency for mechanical time fuzes, has selected as prime contractors facilities which have experience in the assembly of intricate mechanisms and have demonstrated marked ability economically to mass produce items requiring rigid dimensional controls.

Among those contractors who have had much success in supplying the Army with large quantities of these fuzes are the George W. Borg Company, Eastman Kodak Company, Gruen Watch Company, Hamilton Watch Company, E. Ingraham Company, King-Seeley Corporation, United States Time Corporation, and the Westclox Division of the General Time Corporation.

Close coöperation among these contractors and various installations of the Ordnance Corps has resulted in a greatly improved end item, increased production, and maximum economy.

A great deal of the success of the Ordnance Corps' mechanical time fuze program is due to the fine coöperation and ingenuity of the subcontractors. Among those vendors who have supplied large quantities of high-quality component parts are the Hunter Douglas Corporation, the Gilman Engineering Corporation, the Grebar Plastic and Rubber Corporation, the Superior Tube Company, Precision Casting Company, Doehler Jarvis Corporation, and the Wallace Barnes Corporation.

Others far too numerous to mention here have also supplied much excellent material. It must be borne in mind that each fuze contains well over one hundred component parts and the prime contractors are purchasing a good number of these components from specialty houses.

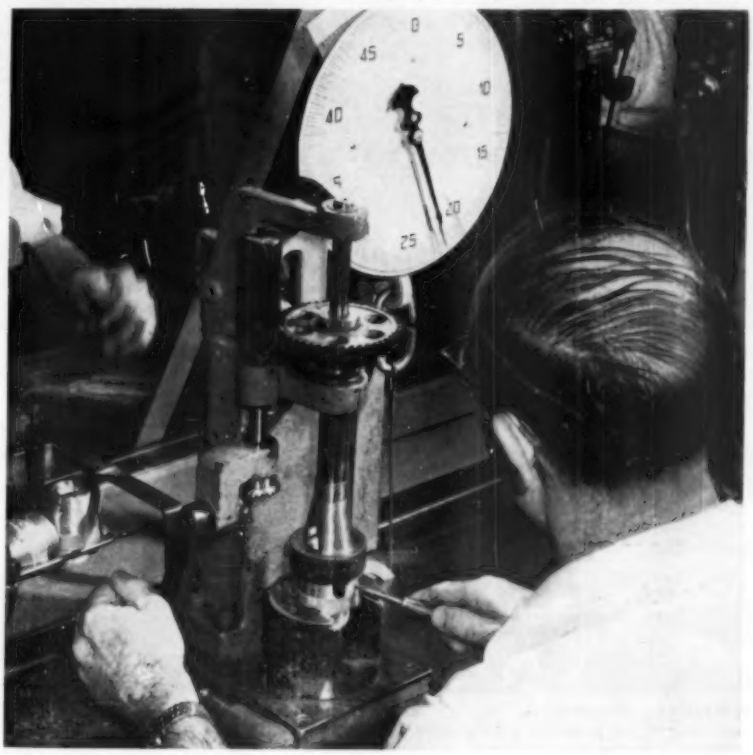
The Ordnance Corps is constantly striving to supply a superior item at a reduced cost. With this in mind, the Gilman Engineering Company of Janesville, Wis., has developed an automatic assembly machine for the complete assembly of the point-detonating feature.

STUDIES currently are being made to determine the feasibility of complete automatization of mechanical time fuze assembly. Should even a moderate amount of success be realized in this development, the cost saving and production rate will certainly prove beneficial to the Ordnance Corps and the taxpayer.

Torsion-type escapement springs and clock-type drive springs are being experimented with in an effort to eliminate input torque variations previously discussed.

New, and it is hoped, better methods and techniques of fuze setting, tensioning, waterproofing, and zeroing will enable the Ordnance Corps to supply the Field Forces with even better cechanical time fuzes.

Torque between lower cap and body of fuze being adjusted to requirements by technician at the U. S. Time Corporation plant, Waterbury, Conn.



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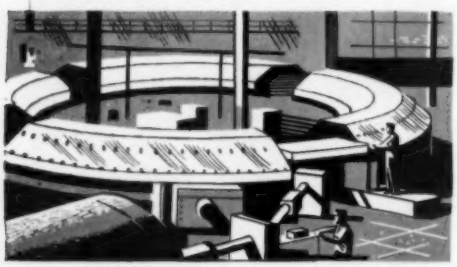

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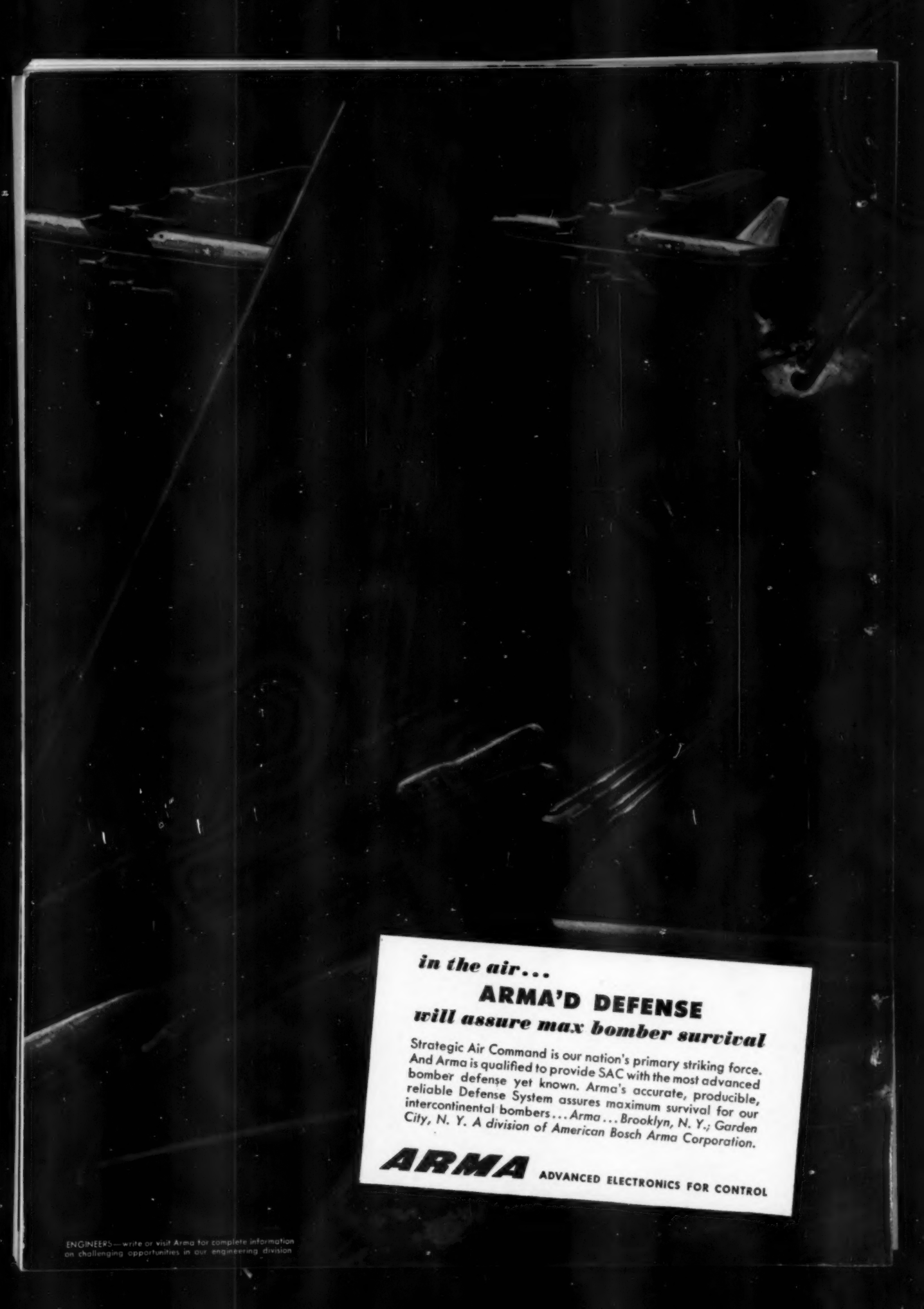
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